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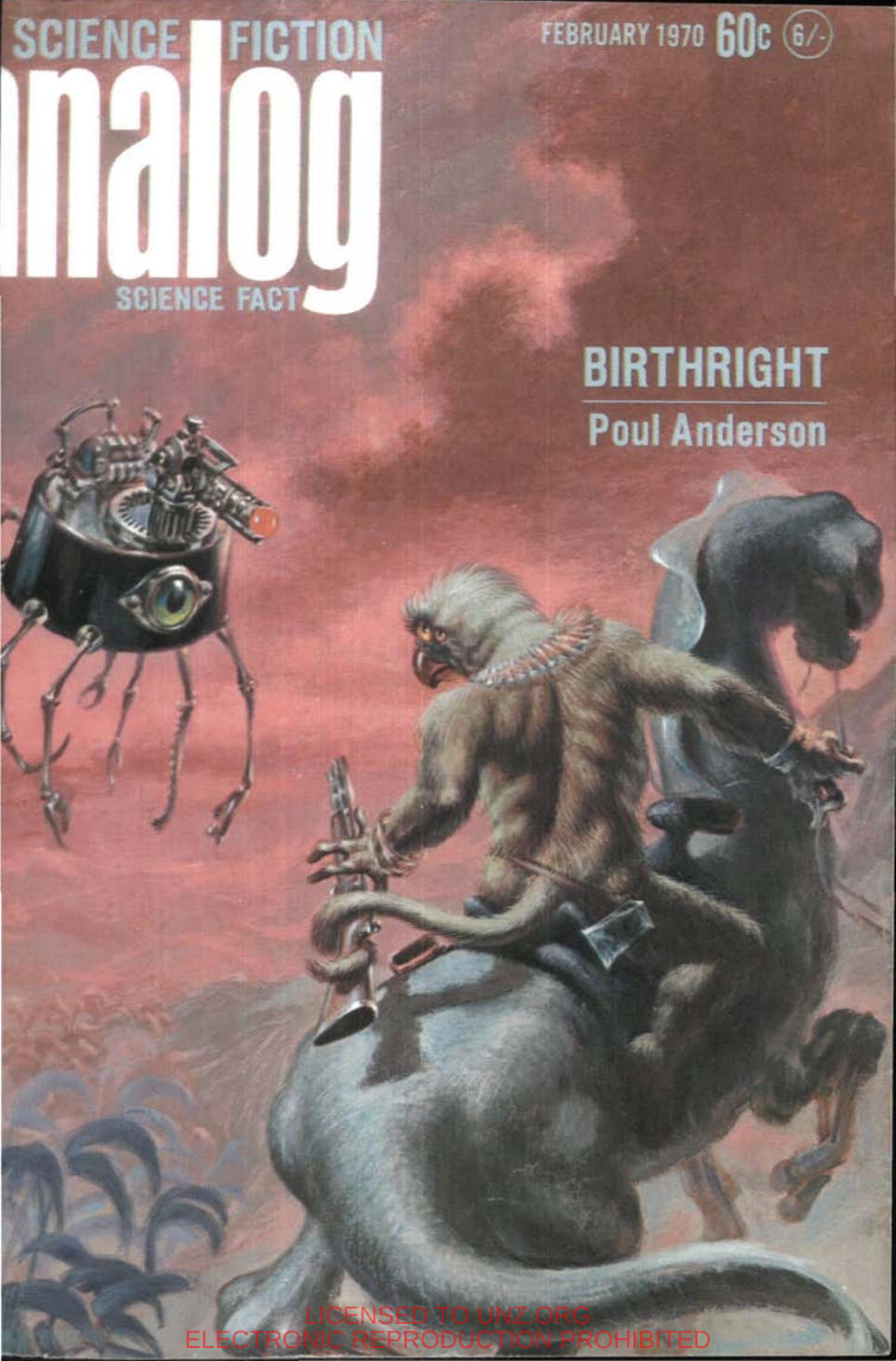
FEBRUARY 1970 60c 6/-

BIRTHRIGHT

Poul Anderson



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A. No. On Payroll Savings, Freedom Shar deductions are limited to $20.25 per weekly pay period, $40.50 per bi-weekly or semimonthly pay period, $81.00 per mont pay period. On Bond-a-Month, the limit o Freedom Share deductions is $81.00 per month.

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editorial by John W. Campbell

MR. EDISON'S MAGIC LAMP

One of the unfortunate things about Mr. Edison's wonderful light is that it is not a Magic Lamp. It takes electric power to run it and the host of other things that came into use when the early Edison Electric Company once got started.

A Magical Device is, by popular conception, a *most* desirable thing indeed, since it's Magic only if it yields a Product without the nuisance of a Process.

For most people, the electrical gadgets they find so pleasing are, and of a right ought to be, Magical —except that an ogre called the Electric Power Company keeps annoying them with bills for services rendered.

One of the most popular of all the electrical genii, currently, is the air conditioner; it's now considered a necessity in most middle-class homes. (For a lot of heart patients and asthmatics, it *is* a necessity, too! There are tens of thousands living today who wouldn't have made it without air-conditioning; 90+° heat with a 50% or higher humidity is lethal to a man with a weak heart, even when he's lying down.) When I first started working on this magazine, the home air conditioner was something you read about, or saw pictures of, and on deadly hot days the only relief was to go to the local movie house, the one with the "Twenty Degrees Cooler Inside!" banner hung out in front.

Times seem to have changed slightly, but the public attitude that electrical devices should operate by Magic—without process—has simply deepened and hardened. People want Products—and they do not want Process. Mr. Edison's Magic Lamp works by simply being plugged into the wall, and that ought to be the end of it. None of these nasty Power Plant things!

In New York City, the problem's particularly acute—naturally! With the world's most concentrated megapolis, set in the middle of the super-city that stretches from Boston to Washington, it's inevitable that the problems would be more acute.

Now when Mr. Edison started the practice of electrical engineer-

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ing—he was sold on direct-current power. So the early power systems had dynamos powered by steam engines, and big banks of electric storage batteries "floating on the line."

During the day, there were very few electric lights in use, and since there were almost no other uses for electric power then, there was little current drain on the dynamos. So their power went into the storage batteries. At night, when everybody turned the lights on, the load was considerably greater than the small dynamos could handle—but the batteries carried the load. Batteries floating on the line leveled off the violent peaks and valleys of demand.

As more loads developed, not only did the total demand for current increase, but the pattern of demand changed. Electric motors were developed to something more than toy size and power; they took over jobs running machine tools from the old steam-engine-plus-shaft-and-belt systems. Elevators switched from steam to electricity.

As mills and industrial outfits began using power, the electric power companies joyfully aided the change-over. Because industrial users have a problem exactly equivalent to the power company's own; their machines are expensive, and time costs money. Money borrowed to buy and to build must be paid for at so much per year interest; the more the expensive equipment can be made to produce during that year, the less interest-charge has to be tacked on each unit of product. Any machine sitting idle goes right on costing money in interest charges, taxes, and obsolescence. If the machine is kept working full blast, the interest, taxes, and obsolescence charges don't increase—but the product output does. Wherefore, industrial outfits of every kind want as close to full-time full-load operation as they can arrange.

Precisely as the power companies do.

In the dear, dead, Nineteenth Century days of DC power systems with batteries floating on the line, the power companies approached that situation. Their generators ran all day and night charging batteries, and the batteries carried the load that came on each evening.

While the major load on power plants remained strictly local, and largely home-lighting, DC had it all over AC. You could store it, and thus flatten out the peak loads, and so keep your expensive equipment in full production twenty-four hours a day.

As the industrial load built up, peak-flattening became less of a problem. As an extreme example, consider the pattern at Oak Ridge, Tennessee. There's a town there, that has the usual pattern of peak loads as evening comes on, electric stoves start cooking dinner, lights go on, and home workshops start

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machine tools going, as in cities all across the country.

But that load doesn't even flicker a needle in the distribution board for Oak Ridge. The immense uranium-isotope separation plant has *n*-thousand motors driving *n*-thousand pumps, and running electrochemical pots and compressors and electric furnaces and assorted high-technology devices. Oak Ridge is one of the three major plants on Earth that supply the enriched uranium fuels for nuclear power plants not only in the United States, but in most of the rest of the world as well. That plant consumes enormous quantities of electric power—on a steady, level, twenty-four-hours-a-day, three-hundred-sixty-five-days-a-year basis. There's no need for a storage battery peak-leveler there; it takes power continuously. Power-plant equipment can be built of the correct size, fired up, and left running as long as it runs; it will be fully utilized, and produce power at minimum cost as a result.

The domestic load of the Oak Ridge community flickering on and off is less than the changes that occur when a fluorine reduction pot-line is shut down for routine maintenance. It's the sort of load pattern that a utility company loves to supply.

Now let's consider the other extreme.

An aerospace research lab wanted to do serious research on plasma physics, working with extreme-intensity arcs operating at about 5,000 volts at 10,000 amperes. Not, be it noted, for long! That's 50,000,000 watts—and nobody and no equipment continues to exist for any length of time near an energy release of that magnitude, and that intensity. They wanted to run the arc for periods of thirty to sixty seconds at a time, and then study the recordings made during that brief excursion to near-stellar conditions.

The power company wanted nothing whatever to do with *that* load! You've seen your home lights dim slightly, and then recover when some major appliance started up—a large-sized air conditioner, for instance. A power distribution system is a complicated thing of lines, tie lines, transformers, substations, voltage-regulators, automatic regulators, phase-correctors, and overload devices. Drop a sudden fifty megawatt load onto that network, as the plasma arc started, and the system would stagger. All over the system, the automatic regulators would start stepping switches around to compensate for the sudden voltage drop. Generators directly affected by that load would slow down, and tend to drop out of phase with the rest of the net, and automatic regulators would take compensating action to bring voltage and speed back where it belonged.

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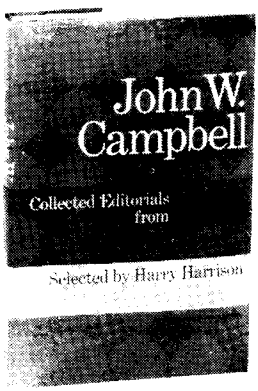

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And then somebody pulls the switch and lifts the fifty megawatt load off of the line, all at once.

The whole system would *twang* like a plucked string. Wild oscillations of voltage, current, and phase would set in—and temporarily excursions of voltage would cause insulation breakdowns, burn out lights, TV sets, motors and assorted equipment all over the net.

The research group was invited to go build their own fifty megawatt generator system, and feel free to play any games they wanted with that.

In general, the ideal load for a utility is a large number of industrial plants which run twenty-four hours a day, all year round. A large number, so that the normal fluctuations of activity due to shutdowns for maintenance, new machine installation, et cetera, will be statistically leveled out.

One of the least desirable loads is an extremely large city with relatively little heavy industry—because then the load is almost all domestic and commercial office demand, and it goes through those diurnal peaks.

Complicating life for the non-magical electric process are the air-conditioner loads. Their behavior as loads is *not* random-statistical. *continued on page 173*

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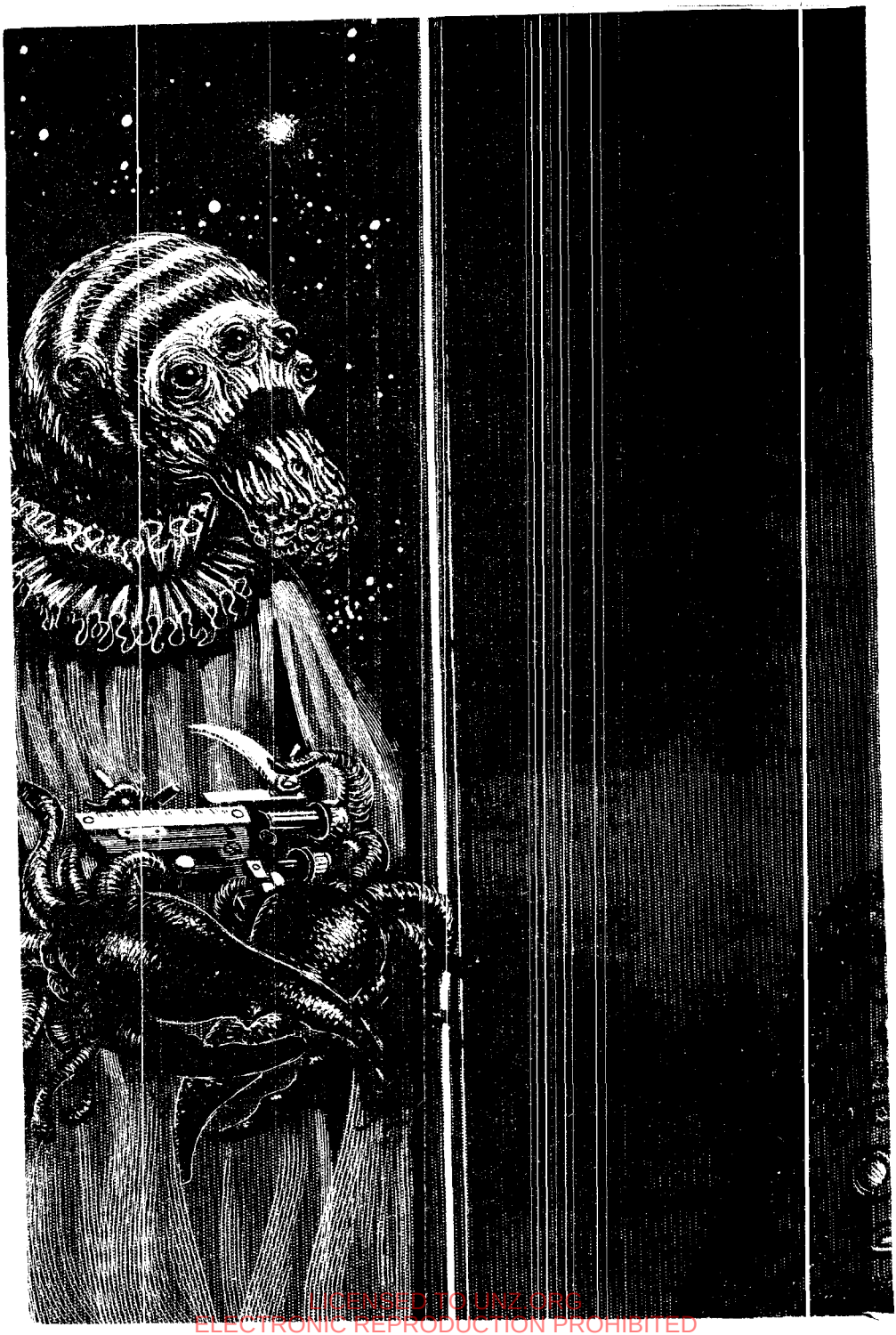

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To be employed as a manager
in the Solar Spice and Liquors Company required
a certain failing. For business is,
in essence, the unending battle of economics.

POUL ANDERSON

Illustrated by Kelly Freas

The cab obtained clearance from certain machines and landed on the roof of the Winged Cross. Emil Dalmady paid and stepped out. When it took off, he felt suddenly very alone. The garden was fragrant around him in a warm deep-blue summer's dusk; at this height, the sounds of Chicago Integrate were a murmur as of a distant ocean; the other towers and the skyways between them were a forest through which flitted will-o'-the-wisp aircars and beneath which—as if Earth had gone transparent—a fantastic galaxy of many-colored lights was blinking awake farther than eye could reach. But the penthouse bulking ahead might have been a hill where a grizzly bear had its den.

The man squared his shoulders. *Haul in,* he told himself. *He won't eat you.* Anger lifted afresh. *I might just eat him.* He strode forward: a stocky, muscular figure in a blue zipskin, features broad and high of cheekbones, snubnosed, eyes green and slightly tilted, hair reddish black.

But despite stiffened will, the fact remained that he had not expected a personal interview with any merchant prince of the Polesotechnic League, and in one of the latter's own homes. When a live butler had admitted him, and he had crossed an improbably long stretch of trollcat rug to the View-Wall end of a luxury-cluttered living room, and was confronting Nicholas van Rijn, his throat tightened and his palms grew wet.

"Good evening," the host rumbled. "Welcome." His corpulent corpus did not rise from the lounger. Dalmady didn't mind. Not only bulk but height would have dwarfed him. Van Rijn waved a hand at a facing seat; the other gripped a liter tankard of beer. "Sit. Relax. You look quivery like a

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blanc-mange before a firing squad. What you drink, smoke, chew, sniff, or elsewise make amusements with?"

Dalmady lowered himself to an edge. Van Rijn's great hook-beaked, multi-chinned, moustached and goateed visage, framed in black shoulder-length ringlets, crinkled with a grin. Beneath the sloping brow, small jet eyes glittered at the newcomer. "Relax," he urged again. "Give the form-fitting a chance. Not so fun-making an embrace like a pretty girl, but less extracting, ha? I think maybe a little glass Genever and bitters over dry ice is a tranquilizator for you." He clapped.

"Sir," Dalmady said, harshly in his tension, "I don't want to seem ungracious, but—"

"But you came to Earth breathing flame and brimrocks, and went through six echelons of the toughest no-saying secretaries and officers what the Solar Spice and Liquors Company has got, like a bulldozer chasing a cowdozer, demanding to see whoever the crockhead was what fired you after what you done yonderways. Nobody had a chance to explain. Trouble was, they assumptioned you knew things what they take for granted. So natural, what they said sounded to you like a flushoff and you hurricaned your way from them to somebody else."

Van Rijn offered a cigar out of a gold humidor whose workmanship Dalmady couldn't identify except that it was nonhuman. The young man shook his head. The merchant selected one himself, bit off the end and spat that expertly into a receptor, and inhaled the tobacco to ignition. "Well," he continued, "somebody would have got through into you at last, only then I learned about you and ordered this meeting. I would have wanted to talk at you anyhows. Now I shall clarify everything like Hindu butter."

His geniality was well-nigh as overwhelming as his wrath would have been, assuming the legends about him were true. *And he could be setting me up for a thunderbolt*, Dalmady thought, and clung to his indignation as he answered:

"Sir, if your outfit is dissatisfied with my conduct on Suleiman, it might at least have told me why, rather than sending a curt message that I was being replaced and should report to HQ. Unless you can prove to me that I bungled, I will not accept demotion. It's a question of personal honor more than professional standing. They think that way where I come from. I'll quit. And . . . there are plenty of other companies in the League that will be glad to hire me."

"True, true, in spite of every candle I burn to St. Dismas." Van Rijn sighed through his cigar, engulfing Dalmady in smoke. "Always they try to pirate my executives what have not yet sworn fealty, like the

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thieves they are. And I, poor old lonely fat man, trying to run this enterprise personal what stretches across so many whole worlds, even with modern computer technology I get melted down from overwork, and too few men for helpers what is not total gruntbrains, and some of them got to be occupied just luring good executives away from elsewhere." He took a noisy gulp of beer. "Well."

"I suppose you've read my report, sir," was Dalmady's gambit.

"Today. So much information flowing from across the light-years, how can this weary old noggle hold it without data flowing back out like ear wax? Let me review to make sure I got it tesseract. Which means—ho, ho!—straight in four dimensions."

Van Rijn wallowed deeper into his lounger, bridged hairy fingers, and closed his eyes. The butler appeared with a huge steaming and hissing goblet. *If this is his idea of a small drink*—! Dalmady thought. Grimly, he forced himself to sit at ease and sip.

"Now." The cigar waggled in time to the words. "This star what its discoverer called Osman is out past Antares, on the far edge of present-day regular-basis League activities. One planet is inhabited, called by humans Suleiman. Subjovian; life based on hydrogen, ammonia, methane; primitive natives, but friendly. Turned out, on the biggest continent grows a plant we call . . . um-m-m . . . bluejack, what the natives use for a spice and tonic. Analysis showed a complicated blend of chemicals, answering sort of to hormonal stuffs for us, with synergistic effects. No good to oxygen breathers, but maybe we can sell to hydrogen breathers elsewhere.

"Well, we found very few markets, at least what had anythings to offer we wanted. You need a special biochemistry for bluejack to be beneficent. So synthesis would cost us more, counting investment and freight charges from chemical-lab centers, than direct harvesting by natives on Suleiman, paid for in trade goods. Given that, we could show a wee profit. Quite teensy—whole operation is near-as-damn marginal—but as long as things stayed peaceful, well, why not turn a few honest credits?

"And things was peaceful, too, for years. Natives cooperated fine, bringing in bluejack to warehouses. Outshipping was one of those milk runs where we don't knot up capital in our own vessels, we contract with a freighter line to make regular calls. Oh, *ja*, contretemps kept on *countertiming*—bad seasons, bandits raiding caravans, kings getting too greedy about taxes—usual stuffing, what any competent factor could handle on the spot, so no reports about it ever come to pester me.

"And then . . . Ahmed, more

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beer! . . . real trouble. Best market for bluejack is on a planet we call Babur. Its star, Mogul, lies in the same general region, about thirty light-years from Osman. Its top country been dealing with Technic civilization off and on for decades. Trying to modernize, they was mainly interested in robotics for some reason; but at last they did pile together enough outplanet exchange for they could commission a few hyperdrive ships built and crews trained. So now the Solar Commonwealth and other powers got to treat them with a little more respect. Blast cannon and nuclear missiles sure improve manners, by damn! They is still small tomatoes, but ambitious. And to them, with the big domestic demand, bluejack is not an incidental thing."

Van Rijn leaned forward, wrinkling the embroidered robe that circled his paunch. "You wonder why I tell you what you know, ha?" he said. "When I need direct reports on a situation, especial from a world as scarcely known as Suleiman, I can't study each report from decades. Data retrieval got to make me an abstract. I check with you now, who was spotted there, whether the machine give me all what is significant to our talking. Has I been correct so far?"

"Yes," Dalmady said. "But—"

Yvonne Vaillancourt looked up from a console as the factor passed the open door of her collation lab. "What's wrong, Emil?" she asked. "I heard you clattering the whole way down the hall."

Dalmady stopped for a look. Clothing was usually at a minimum in the Earth-conditioned compound, but, while he had grown familiar with the skins of its inhabitants, he never tired of hers. Perhaps, he had thought, her blond shapeliness impressed him the more because he had been born and raised on Altai. The colonists of that chill planet went heavily dressed of necessity. The same need to survive forced austere habits on them: and, isolated in a largely unexplored frontier section, they received scant news about developments in the core civilization.

When you were one of half a dozen humans on a world whose very air was death to you—when you didn't even have visitors of your own species, because the ship that regularly called belonged to a Cynthian carrier—you had no choice but to live in free and easy style. Dalmady had had that explained to him while he was being trained for this post, and recognized it and went along with it. But he wondered if he would ever become accustomed to the *casualness* of the sophisticates whom he bossed.

"I don't know," he answered the girl. "The Thalassocrat wants me at the palace."

"Why, he knows perfectly well how to make a visi call."

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"Yes, but a nomad's brought word of something nasty in the Uplands, and won't come near the set. Afraid it'll imprison his soul, I imagine."

"Hm-m-m, I think not. We're still trying to chart the basic Suleimanite psychology, you know, with only inadequate data from three or four cultures to go on . . . but they don't seem to have animistic tendencies like man's. Ceremony, yes, in abundance, but nothing we can properly identify as magic or religion."

Dalmady barked a nervous laugh. "Sometimes I think my whole staff considers our commerce an infernal nuisance that keeps getting in the way of their precious science."

"Sometimes you'd be right," Yvonne purred. "What'd hold us here except the chance to do research?"

"And how long would your research last if the company closed down this base?" he flared. "Which it will if we start losing money. My job's to see that we don't. I could use cooperation."

She slipped from her stool, came to him and kissed him lightly. Her hair smelled like remembered steppe grass warmed by an orange sun, rippling under the rings of Altai. "Don't we help?" she murmured. "I'm sorry, dear."

He bit his lip and stared past her, down the length of gaudy murals whose painting had beguiled much idle time over the years. "No, I'm sorry," he said with the stiff honesty of his folk. "Of course you're all loyal and—It's me. Here I am, the youngest among you, a half-barbarian herdboy, supposed to make a go of things . . . in one of the easiest, most routinized outposts in this sector . . . and after a bare fifteen months—"

If I fail, he thought, *well, I can return home, no doubt, and dismiss the sacrifices my parents made to send me to managerial school offplanet, scorn the luck that Solar Spice and Liquors had an opening here and no more experienced employee to fill it, forget every dream about walking in times to come on new and unknown worlds that really call forth every resource a man has to give. Oh, yes, failure isn't fatal, except in subtler ways than I have words for.*

"You fret too much." Yvonne patted his cheek. "Probably this is just another tempest in a chickenhouse. You'll bribe somebody, or arm somebody, or whatever's needful, and that will once again be that."

"I hope so. But the Thalassocrat acted—well, not being committed to xenological scholarly precision, I'd say he acted worried, too." Dalmady stood a few seconds longer, scowling, before: "All right, I'd better be on my way." He gave her a hug. "Thanks, Yvonne."

She watched him till he was out of sight, then returned to her work.

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Officially she was the trade post's secretary-treasurer, but such duties seldom came to her except when a freighter had landed. Otherwise she used the computers to try to find patterns in what fragments of knowledge her four colleagues could wrest from a world—an entire, infinitely varied world—and hoped that a few scientists elsewhere might eventually scan a report on Suleiman—one among thousands of planets—and be interested.

Airsuit donned, Dalmady left the compound by its main personnel lock. Wanting time to compose himself, he went afoot through the city to the palace—if they were city and palace.

He didn't know. Books, tapes, lectures, and neuroinductors had crammed him with information about this part of this continent; but those were the everyday facts and skills needed to manage operations. Long talks with his subordinates here had added a little insight, but only a little. Direct experience with the autochthons was occasionally enlightening, but just as apt to be confusing. No wonder that, once a satisfactory arrangement was made with Coast and Upland tribes (?), his predecessors had not attempted expansion or improvement. When you don't understand a machine, but it seems to be running reasonably smoothly, you don't tinker much.

Outside the compound's force field, local gravity dragged at him with forty percent greater pull than Earth's. Though his suit was light and his muscles hard, the air recycler necessarily included the extra mass of a unit for dealing with the hydrogen that seeped through any material. Soon he was sweating. Nevertheless it was as if the chill struck past all thermostatic coils, into his heavy bones.

High overhead stood Osman, a furious white spark, twice as luminous as Sol but, at its distance, casting a bare sixteenth of what Earth gets. Clouds, tinged red by organic compounds, drifted on slow winds through a murky sky where one of the three moons was dimly visible. That atmosphere bore thrice a terrestrial standard pressure. It was mostly hydrogen and helium, with vapors of methane and ammonia and traces of other gas. Greenhouse effect did not extend to unfreezing water.

Indeed, the planetary core was overlaid by a shell of ice, mixed with rock, penetrated by tilted metal-poor strata. The land glittered amidst its grayness and scrunched beneath Dalmady's boots. It sloped down to a dark, choppy sea of liquid ammonia whose horizon was too remote—given a 17,000-kilometer radius—for him to make out through the red-misted air.

Ice also were the buildings that rose blocky around him. They shimmered glasslike where door-

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ways, or obscure carved symbols, did not break their smoothness. There were no streets in the usual sense, but aerial observation has disclosed an elaborate pattern in the layout of structures, about which the dwellers could not or would not speak. Wind moved ponderously between them. The air turned its sound, every sound, shrill.

Traffic surged. It was mainly pedestrian, natives on their business, carrying the oddly shaped tools and containers of a fireless neolithic nonhuman culture. A few wagons lumbered in with produce from the hinterland; their draught animals suggested miniature dinosaurs modeled by someone who had heard vague rumors of such creatures. A related, more slender species was ridden. Coracles bobbed across the sea; you might as well say the crews were fishing, though a true fish could live here unprotected no longer than a man.

Nothing reached Dalmady's earphones except the wind, the distant wave-rumble, the clop of feet and creak of wagons. Suleimanites did not talk casually. They did communicate, however, and without pause: by gesture, by ripple across erectile fur, by delicate exchanges between scent glands. They avoided coming near the human, but simply because his suit was hot to their touch. He gave and received many signals of greeting. After two years—twenty-five of Earth's—Coast and Uplands alike were becoming dependent on metal and plastic and energy-cell trade goods. Local labor had been eagerly available to help build a spaceport on the mesa overlooking town, and still did most of the work. That saved installing automatic machinery—one reason for the modest profit earned by this station.

Dalmady leaned into his uphill walk. After ten minutes he was at the palace.

The half-score natives posted outside the big, turreted building were not guards. While wars and robberies occurred on Suleiman, the slaying of a "king" seemed to be literally unthinkable. (An effect of pheromones? In every community the xenologists had observed thus far, the leader ate special foods which his followers insisted would poison anyone else; and maybe the followers were right.) The drums, plumed canes, and less identifiable gear which these beings carried were for ceremonial use.

Dalmady controlled his impatience and watched with a trace of pleasure the ritual of opening doors and conducting him to the royal presence. The Suleimanites were a graceful and handsome species. They were plantigrade bipeds, rather like men although the body was thicker and the average only came to his shoulder. The hands each bore two fingers between two

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thumbs, and were supplemented by a prehensile tail. The head was round, with a parrotlike beak, tympani for hearing, one large golden-hued eye in the middle and two smaller, less developed ones for binocular and peripheral vision. Clothing was generally confined to a kind of sporran, elaborately patterned with symbols, to leave glands and mahogany fur available for signals. The fact that Suleimanite languages had so large a nonvocal component handicapped human efforts at understanding as much as anything else did.

The Thalassocrat addressed Dalmady by voice alone, in the blue-glimmering ice cavern of his audience room. Earphones reduced the upper frequencies to some the man could hear. Nonetheless, that squeak and gibber always rather spoiled the otherwise impressive effect of flower crown and carven staff. So did the dwarfs, hunchbacks, and cripples who squatted on rugs and skin-draped benches. It was not known why household servants were always recruited among the handicapped. Suleimanites had tried to explain when asked, but their meaning never came through.

"Fortune, power, and wisdom to you, Factor." They didn't use personal names on this world, and seemed unable to grasp the idea of an identification which was not a scent-symbol.

"May they continue to abide with you, Thalassocrat." The vocalizer on his back transformed Dalmady's version of local speech into sounds that his lips could not bring forth.

"We have here a Master of caravaneers," the monarch said.

Dalmady went through polite ritual with the Uplander, who was tall and rangy for a Suleimanite, armed with a stoneheaded tomahawk and a trade rifle designed for his planet, his barbarianism showing in gaudy jewels and bracelets. They were O.K., however, those hill country nomads. Once a bargain had been struck, they held to it with more literal-mindedness than humans could have managed.

"And what is the trouble for which I am summoned, Master? Has your caravan met bandits on its way to the Coast? I will be glad to equip a force for their suppression."

Not being used to talking with men, the chief went into full Suleimanite language—his own dialect, at that—and became incomprehensible. One of the midgets stumped forward. Dalmady recognized him. A bright mind dwelt in that poor little body, drank deep of whatever knowledge about the universe was offered, and in return had frequently helped with counsel or knowledge. "Let me ask him out, Factor and Thalassocrat," he suggested.

"If you will, Advisor," his overlord agreed.

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"I will be in your debt, Translator," Dalmady said, with his best imitation of the prancing thanks-gesture.

Beneath the courtesies, his mind whirred and he found himself holding his breath while he waited. Surely the news couldn't be really catastrophic!

He reviewed the facts, as if hoping for some hitherto unnoticed salvation in them. With little axial tilt, Suleiman lacked seasons. Bluejack needed the cool, dry climate of the Uplands, but there it grew the year around. Primitive natives, hunters and gatherers, picked it in the course of their wanderings. Every several months, terrestrial, such a tribe would make rendezvous with one of the more advanced nomadic herding communities, who bartered for the parched leaves and fruits. A caravan would then form and make the long trip to this city, where Solar's folk would acquire the bales in exchange for Technic merchandise. You could count on a load arriving about twice a month. Four times in an Earthside year, the Cynthian vessel took away the contents of Solar's warehouse . . . and left a far more precious cargo of letters, tapes, journals, books, news from the stars that were so rarely seen in these gloomy heavens.

It wasn't the most efficient system imaginable, but it was the cheapest, once you calculated what the cost would be—in capital investment and civilized-labor salaries—of starting plantations. And costs must be kept low or the enterprise would change from a minor asset to a liability, which would soon be liquidated. As matters were, Suleiman was a typical outpost of its kind: to the scientists, a fascinating study and a chance to win reputation in their fields; to the factors, a comparatively easy job, a first step on a ladder at the top of which waited the big, glamorous, gorgeously paid managerial assignments.

Or thus it had been until now.

The Translator turned to Dalmady. "The Master says this," he piped. "Lately in the Uplands have come what he calls . . . no, I do not believe that can be said in words alone—It is clear to me, they are machines that move about harvesting the bluejack."

"What?" The man realized he had exclaimed in Anglic. Through suddenly loud pulses, he heard the Translator go on:

"The wild folk were terrified and fled those parts. The machines came and took what they had stored against their next rendezvous. That angered this Master's nomads, who deal there. They rode to protest. From afar they saw a vessel, like the great flying vessel that lands here, and a structure a-building. Those who oversaw that work were . . . low, with many legs and claws for hands . . . long noses— A gathering robot

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came and shot lightning past the nomads. They saw they, too, must flee, lest its warning shot become deadly. The Master himself took a string of remounts and posted hither as swiftly as might be. In words, I cannot say more of what he has to tell."

Dalmady gasped into the frigid blueness that enclosed him. His mouth felt dry, his knees weak, his stomach in upheaval. "Baburites," he mumbled. "Got to be. But why're they doing this to us?"

Brush, herbage, leaves on the infrequent trees, were many shades of black. Here and there a patch of red, or brown, or blue flowering relieved it, or an ammonia river cataracting down the hills. Farther off, a range of ice mountains flashed blindingly; Suleiman's twelve-hour day was drawing to a close, and Osman's rays struck level through a break in roiling ruddy cloud cover. Elsewhere a storm lifted like a dark wall on which lightning scribbled. The dense atmosphere brought its thunder-noise to Dalmady as a high drumroll. He paid scant attention. The gusts that hooted around his car, the air pockets into which it lurched, made piloting a full-time job. A cybernated vehicle would have been too expensive for this niggardly rewarding planet.

"There!" cried the Master. He squatted with the Translator in an after compartment, which was left under native conditions and possessed an observation dome. In deference to his superstitions, or whatever they were, only the audio part of the intercom was turned on.

"Indeed," the Translator said more calmly. "I descry it now. Somewhat to our right, Factor—in a valley by a lake . . . do you see?"

"A moment." Dalmady locked the altitude controls. The car would bounce around till his teeth rattled, but the grav field wouldn't let it crash. He leaned forward in his harness, tried to ignore the brutal pull on him, and adjusted the scanner screen. His race had not evolved to see at those wavelengths which penetrated this atmosphere best; and the distance was considerable, as distances tend to be on a subjovian.

Converting light frequencies, amplifying, magnifying, the screen flung a picture at him. Tall above shrubs and turbulent ammonia stood a spaceship. He identified it as a Holbert-X freighter, a type commonly sold to hydrogen breathers. There had doubtless been some modifications to suit its particular home world, but he saw none except a gun turret and a couple of missile tube housings.

A prefabricated steel and ferrocrete building was being assembled nearby. The construction robots must be working fast, without pause; the cube was already more than half finished. Dalmady

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glimpsed flares of energy torches, like tiny blue novas. He couldn't make out individual shapes, and didn't want to risk coming near enough.

"You see?" he asked the image of Peter Thorson, and transmitted the picture to another screen.

Back at the base, his engineer's massive head nodded. Behind could be seen the four remaining humans. They looked as strained and anxious as Dalmady felt, Yvonne perhaps more so.

"Yeh. Not much we can do about it," Thorson declared. "They pack bigger weapons. And see, in the corners of the barn, those bays? That's for blast cannon, I swear. Add a heavy-duty forcefield generator for passive defense, and it's a nut we can't hope to crack."

"The home office—"

"Yeh, they *might* elect to resent the invasion and dispatch a regular warcraft or three. But I don't believe it. Wouldn't pay, in economic terms. And it'd make every kind of hooraw, because remember, SSL hasn't got any legal monopoly here." Thorson shrugged. "My guess is, Old Nick'll simply close down on Suleiman, probably wangling a deal with the Baburites that'll cut his losses and figuring to diddle them good at a later date." He was a veteran mercantile professional, accustomed to occasional setbacks, indifferent to the scientific puzzles around him.

Yvonne, who was not, cried softly, "Oh, no! We can't! The insights we're gaining—"

And Dalmady, who could not afford a defeat this early in his career, clenched one fist and snapped, "We can at least talk to them, can't we? I'll try to raise them. Stand by." He switched the outercom to a universal band and set the Come In going. The last thing he had seen from the compound was her stricken eyes.

The Translator inquired from aft: "Do you know who the strangers are and what they intend, Factor?"

"I have no doubt they come from Babur, as we call it," the man replied absently. "That is a world"—the more enlightened Coast dwellers had acquired some knowledge of astronomy—"akin to yours. It is larger and warmer, with heavier air. Its folk could not endure this one for long without becoming sick. But they can move about unarmored for a while. They buy most of our bluejack. Evidently they have decided to go to the source."

"But why, Factor?"

"For profit, I suppose, Translator." *Maybe just in their nonhuman cost accounting. That's a giant investment they're making in a medicinal product. But they don't operate under capitalism, under anything that human history ever saw, or so I've heard. Therefore they may consider it an investment*

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in . . . empire? No doubt they can expand their foothold here, once we're out of the way—"

The screen came to life.

The being that peered from it stood about waist high to a man in its erect torso. The rest of the body stretched behind in a vaguely caterpillar shape, on eight stumpy legs. Along that glabrous form was a row of opercula protecting tracheae which, in a dense hydrogen atmosphere aerated the organism quite efficiently. Two arms ended in claws reminiscent of a lobster's; from the wrists below sprouted short, tough finger-tendrils. The head was dominated by a spongy snout. A Baburite had no mouth. It—individuals changed sex from time to time—macerated food with the claws and put it in a digestive pouch to be dissolved before the snout sucked it up. The eyes were four, and tiny. Speech was by diaphragms on either side of the skull, hearing and smell were associated with the tracheae. The skin was banded orange, blue, white, and black. Most of it was hidden by a gauzy robe.

The creature would have been an absurdity, a biological impossibility, on an Earth-type world. In its own ship, in strong gravity and thick cold air and murk through which shadowy forms moved, it had dignity and power.

It thrummed noises which a vocalizer rendered into fairly good League Latin: "We were expecting you. Do not approach closer."

Dalmady moistened his lips. He felt cruelly young and helpless. "G-g-greeting. I am the factor."

The Baburite made no comment.

After a while, Dalmady plowed on: "We have been told that you . . . well, you are seizing the bluejack territory. I cannot believe that is correct."

"It is not, precisely," said the flat mechanical tone. "For the nonce, the natives may use these lands as heretofore, except that they will not find much bluejack to harvest. Our robots are too effective. Observe."

The screen flashed over to a view of a squat, cylindrical machine. Propelled by a simple grav drive, it floated several centimeters off the ground. Its eight arms terminated in sensors, pluckers, trimmers, brush cutters. On its back was welded a large basket. On its top was a maser transceiver and a swivel-mounted blaster.

"It runs off accumulators," the unseen Baburite stated. "These need only be recharged once in thirty-odd hours, at the fusion generator we are installing, unless a special energy expenditure occurs . . . like a battle, for instance. High-hovering relay units keep the robots in constant touch with each other and with a central computer, currently in the ship, later to be in the blockhouse. It controls them all simultaneously, greatly reducing the cost per unit." With no trace of

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sardonicism: "You will understand that such a beamcasting system cannot feasibly be jammed. The computer will be provided with missiles as well as guns and defensive fields. It is programmed to strike back at any attempt to hamper its operations."

The robot's image disappeared, the being's returned. Dalmady felt faint. "But that would . . . would be . . . an act of war!" he stuttered.

"No. It would be self-protection, legitimate under the rules of the Polesotechnic League. You may credit us with the intelligence to investigate the social as well as physical state of things before we acted and, indeed, to become an associate member of the League. No one will suffer except your company. That will not displease its competitors. They have assured our representatives that they can muster enough Council votes to prevent sanctions. It is not as if the loss were very great. Let us recommend to you personally that you seek employment elsewhere."

Uh-huh . . . after I dropped a planet . . . I might maybe get a job cleaning latrines some place, went through the back of Dalmady's head. "No," he protested, "what about the autochthons? They're hurting already."

"When the land has been cleared, bluejack plantations will be established," the Baburite said. "Doubtless work can be found for some of the displaced savages, if they are sufficiently docile. Doubtless other resources, ignored by you oxygen breathers, await exploitation. We may in the end breed colonists adapted to Suleiman. But that will be of no concern to the League. We have investigated the practical effect of its prohibition on imperialism by members. Where no one else is interested in a case, a treaty with a native government is considered sufficient, and native governments with helpful attitudes are not hard to set up. Suleiman is such a case. A written-off operation that was never much more than marginal, out on an extreme frontier, is not worth the League's worrying about."

"The principle—"

"True. We would not provoke war, nor even our own expulsion and a boycott. However, recall that you are not being ordered off this planet. You have simply met a superior competitor, superior by virtue of living closer to the scene, being better suited to the environment and far more interested in succeeding here. We have the same right to launch ventures as you."

"What do you mean, 'we'?" Dalmady whispered. "Who are you? What are you? A private company, or—"

"Nominally, we are so organized, though like many other League associates we make no secret of this being *pro forma*," the

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Baburite told him. "Actually, the terms on which our society must deal with the Technic aggregate have little relevance to the terms of its interior structure. Considering the differences—sociological, psychological, biological—between us and you and your close allies, our desire to be free of your civilization poses no real threat to the latter and hence will never provoke any real reaction. At the same time, we will never win the freedom of the stars without the resources of modern technology.

"To industrialize with minimum delay, we must obtain the initial capacity through purchases from the Technic worlds. This requires Technic currency. Thus, while we spend what appears to be a disproportionate amount of effort and goods on this bluejack project, it will result in saving outplanet exchange for much more important things.

"We tell you what we tell you in order to make clear, not only our harmlessness to the League as a whole, but our determination. We trust you have taped this discussion. It may prevent your employer from wasting our time and energy in counteracting any foredoomed attempts by him to recoup. While you remain on Suleiman, observe well. When you go back, report faithfully."

The screen blanked. Dalmady tried for minutes to make the connection again, but got no answer.

Thirty days later, which would have been fifteen of Earth's, a conference met in the compound. Around a table, in a room hazed and acrid with smoke, sat the humans. In a full-size screen were the images of the Thalassocrat and the Translator, a three-dimensional realism that seemed to breathe out the cold of the ice chamber where they crouched.

Dalmady ran a hand through his hair. "I'll summarize," he told them wearily. The Translator's fur began to move, his voice to make low whistles, as he rendered from the Anglic for his king. "The reports of our native scouts were waiting for me, recorded by Yvonne, when I returned from my own latest flit a couple of hours ago. Each datum confirms every other.

"We'd hoped, you recall, that the computer would be inadequate to cope with us, once the Baburite ship had left."

"Why should the live crew depart?" Sanjuro Nakamura asked.

"That's obvious," Thorson said. "They may not run their domestic economy the way we run ours, but that doesn't exempt them from the laws of economics. A planet like Babur—actually, a single dominant country on it, or whatever they have—still backward, still poor, has limits on what it can afford. They may enjoy shorter lines of communication than we do, but we, at home, enjoy a lot more productivity. At their present stage,

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they can't spend what it takes to create and maintain a permanent, live-staffed base like ours. Suleiman isn't too healthy for them, either, you know; and they lack even our small background of accumulated experience. So they've got to automate at first, and just send somebody once in a while to check up and collect the harvest."

"Besides," Alice Bergen pointed out, "the nomads are sworn to us. They wouldn't make a deal with another party. Not that the Baburites could use them profitably anyway. We're sitting in the only suitable depot area, the only one whose people have a culture that makes it easy to train them in service jobs for us. So the Baburites have to operate right on the spot where the bluejack grows. The nomads resent having their caravan trade ended, and would stage guerrilla attacks on live workers."

"Whew!" Nakamura said, with an attempted grin. "I assure you, my question was only rhetorical. I simply wanted to point out that the opposition would not have left everything in charge of a computer if they weren't confident the setup would function, including holding us at bay. I begin to see why their planners concentrated on developing robotics at the beginning of modernization. No doubt they intend to use machines in quite a few larcenous little undertakings."

"Do you know how many robots there are?" Isabel asked.

"We estimate a hundred," Dalmady told her, "though we can't get an accurate count. They operate fast, you see, covering a huge territory—in fact, the entire territory where bluejack grows thickly enough to be worth gathering—and they're identical in appearance except for the relay hoverers."

"That must be some computer, to juggle so many at once, over such varying conditions," Alice remarked. Cybernetics was not her field.

Yvonne shook her head; the gold tresses swirled. "Nothing extraordinary. We have long-range telephotos, taken during its installation. It's a standard multi-channel design, only the electronics modified for ambient conditions. Rudimentary awareness: more isn't required, and would be uneconomic to provide, when its task is basically simple."

"Can't we outwit it, then?" Alice asked.

Dalmady grimaced. "What do you think my native helpers and I have been trying to do thereabouts, this past week? It's open country: the relayers detect you coming a huge ways off, and the computer dispatches robots. Not many are needed. If you come too close to the blockhouse, they fire warning blasts. That's terrified the natives. Few of them will approach anywhere near, and in fact the savages are starting to evacuate,

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which'll present us with a nice bunch of hungry refugees. Not that I blame them. A low-temperature organism cooks easier than you or me. I did push ahead, and was fired on for real. I ran away before my armor should be pierced."

"What about airborne attack?" Isabel wondered.

Thorson snorted. "In three rattly cars, with handguns? Those robots fly, too, remember. Besides, the centrum has forcefields, blast cannon, missiles. A naval vessel would have trouble reducing it."

Furthermore," interjected the Thalassocrat, "I am told of a threat to destroy this town by airborne weapons, should a serious assault be made on yonder place. That cannot be risked. Sooner would I order you to depart for aye, and strike what bargain I was able with your enemies."

He can make that stick, Dalmady thought, *by the simple process of telling our native workers to quit.*

Not that that would necessarily make any difference. He recalled the last statement of a nomad Master, as the retreat from a reconnaissance took place, Suleimanites on their animals, man on a gravscooter. "We have abided by our alliance with you, but you not by yours with us. Your predecessors swore we should have protection from skyborne invaders. If you fail to drive off these, how shall we trust you?" Dalmady had pleaded for time and had grudgingly been granted it, since the caravaneers did value their trade with him. *But if we don't solve this problem soon, I doubt the system can ever be renewed.*

"We shall not imperil you," he promised the Thalassocrat.

"How real is the threat?" Nakamura asked. "The League wouldn't take kindly to slaughter of harmless autochthons."

"But the League would not necessarily do more than complain," Thorson said, "especially if the Baburites argue that we forced them into it. They're banking on its indifference, and I suspect their judgment is shrewd."

"Right or wrong," Alice said, "their assessment of the psychopolitics will condition what they themselves do. And what assessment have they made? What do we know about their ways of thinking?"

"More than you might suppose," Yvonne replied. "After all, they've been in contact for generations, and you don't negotiate commercial agreements without having done some studies in depth first. The reason you've not seen much of me, these past days, is that I've buried myself in our files. We possess, right here, a bucketful of information about Babur."

Dalmady straightened in his chair. His pulse picked up the least bit. It was no surprise that a large and varied xenological library ex-

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isted in this insignificant outback base. Microtapes were cheaply reproduced, and you never knew who might chance by or what might happen, so you were routinely supplied with references for your entire sector. "What do we have?" he barked.

Yvonne smiled wryly. "Nothing spectacular, I'm afraid. The usual: three or four of the principal languages, sketches of history and important contemporary cultures, state-of-technology analyses, statistics on stuff like population and productivity—besides the planetology, biology, psychoprofiling, et cetera. I tried and tried to find a weak point, but couldn't. Oh, I can show that this operation must be straining their resources, and will have to be abandoned if it doesn't quickly pay off. But that's just as true of us."

Thorson fumed on his pipe. "If we could fix a gadget— We have a reasonably well-equipped workshop. That's where I've been sweating, myself."

"What had you in mind?" Dalmady inquired. The dullness of the engineer's voice was echoed in his own.

"Well, at first I wondered about a robot to go out and hunt theirs down. I could build one, a single one, more heavily armed and armored." Thorson's hand flopped empty, palm up, on the table. "But the computer has a hundred; and it's more sophisticated by orders of magnitude than any brain I could cobble together from spare cybernetics parts; and as the Thalassocrat says, we can't risk a missile dropped on our spaceport in retaliation, because it'd take out most of the city.

"Afterward I thought about jamming, or about somehow lousing the computer itself, but that's totally hopeless. It'd never let you get near."

He sighed. "My friends, let's admit that we've had the course, and plan how to leave with minimum loss."

The Thalassocrat stayed imperturbable, as became a monarch. But the Translator's main eye filmed over, his tiny body shrank into itself, and he cried: "We had hoped . . . one year our descendants, learning from you, joining you among the uncounted suns— Is there instead to be endless rule by aliens?"

Dalmady and Yvonne exchanged looks. Their hands clasped. He believed the same thought must be twisting in her: *We, being of the League, cannot pretend to altruism. But we are not monsters either. Some cold accountant in an office on Earth may order our departure. But can we who have been here, who like these people and were trusted by them, abandon them and continue to live with ourselves? Would we not forever feel that any blessings given us were stolen?*

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And the old, old legend crashed into his awareness.

He sat for a minute or two, unconscious of the talk that growled and groaned around him. Yvonne first noticed the blankness in his gaze. "Emil," she murmured, "are you well?"

Dalmady sprang to his feet with a whoop.

"What in space?" Nakamura said.

The factor controlled himself. He trembled, and small chills ran back and forth along his nerves; but his words came steady. "I have an idea."

Above the robes that billowed around him in the wind, the Translator carried an inconspicuous miniature audiovisual two-way. Dalmady in the car which he had landed behind a hill some distance off, Thorson in the car which hovered to relay, Yvonne and Alice and Isabel and Nakamura and the Thalassocrat in the city, observed a bobbing, swaying landscape on their tuned-in screens. Black leaves streamed, long and ragged, on bushes whose twigs clicked an answer to the whining air; boulders and ice chunks humped among them; an ammonia fall boomed on the right, casting spray across the field of view. The men in the cars could likewise feel the planet's traction and the shudder of hulls under that slow, thick wind.

"I still think we should've waited for outside help," Thorson declared on a separate screen. "That rig's a real lash-up."

"And I still say," Dalmady retorted, "your job's made you needlessly fussy in this particular case. Besides, the natives couldn't've been stalled much longer." *Furthermore, if we can rout them with nothing but what was on hand, that ought to shine in my record. I'd like to think that's less important to me, but I can't deny it's real.*

One way or another, the decision had to be mine. I am the factor.

It's a lonesome feeling. I wish Yvonne were here beside me.

"Quiet," he ordered. "Something's about to happen."

The Translator had crossed a ridge and was gravscooting down the opposite slope. He required no help at that; a few days of instruction had made him a very fair driver, even in costume. He was entering the robot-held area, and already a skyborne unit slanted to intercept him. In the keen Osman-light, against ocherous clouds, it gleamed like fire.

Dalmady crouched in his seat. He was airsuited. If his friend got into trouble, he'd slap down his faceplate, open the cockpit, and swoop to an attempted rescue. A blaster lay knobby in his lap. The thought he might come too late made a taste of sickness in his mouth.

The robot paused at hover, arms

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extended, weapon pointed. The Translator continued to glide at a steady rate. When near collision, the two-way spoke for him: "Stand aside. We are instituting a change of program."

Spoke, to the listening computer, in the principal language of Babur.

Yvonne had worked out the plausible phrases, and spent patient hours with vocalizer and recorder until they seemed right. Engineer Thorson, xenologists Nakamur and Alice Bergen, artistically inclined biologist Isabel da Fonseca, Dalmady himself and several Suleimanite advisors who had spied on the Baburites, had created the disguise. Largely muffled in cloth, it didn't have to be too elaborate—a torso shaven and painted; a simple mechanical caterpillar body behind, steered by the hidden tail, automatically pacing its six legs with the wearer's two; a flexible mask with piezoelectric controls guided by the facial muscles beneath; claws and tendrils built over the natural arms, fake feet over the pair of real ones.

A human, or an ordinary Suleimanite, could not successfully have worn such an outfit. If nothing else, they were too big. But presumably it had not occurred to the Baburites to allow for midgets existing on this planet. The disguise was far from perfect; but presumably the computer was not programmed to check for any such

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contingency; furthermore, an intelligent, well-rehearsed actor, adapting his role moment by moment as no robot ever can, creates a gestalt transcending any minor errors of detail.

And . . . logically, the computer *must* be programmed to allow Baburites into its presence, to service it and collect the bluejack stored nearby.

Nonetheless, Dalmady's jaws ached from the tension on them.

The robot shifted out of the viewfield. In the receiving screens, ground continued to glide away underneath the scooter.

Dalmady switched off audio transmission from base. Though none save Yvonne, alone in a special room, was now sending to the Translator, and she via a bone conduction receiver—still, the cheers that had filled the car struck him as premature.

But the kilometers passed and passed. And the blockhouse hove in view, dark, cubical, bristling with sensors and antennae, cornered with the sinister shapes of gun emplacements and missile silos. No forcefield went up. Yvonne said through the Translator's unit: "Open; do not close again until told," and the idiot-savant computer directed a massive gate to swing wide.

What happened beyond was likewise Yvonne's job. She scanned through the portal by the two-way, summoned what she had learned

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of Baburite automation technology, and directed the Translator. Afterward she said it hadn't been difficult except for poor visibility; the builders had used standard layouts and programming languages. But to the factor it was an hour of sweating, cursing, pushing fingers and belly muscles against each other, staring and staring at the image of enigmatic units which loomed between blank walls, under bluish light that was at once harsh and wan.

When the Translator emerged and the gate closed behind him, Dalmady almost collapsed.

Afterward, though—well, League people were pretty good at throwing a celebration!

"Yes," Dalmady said. "But—"

"Butter me no buts," van Rijn said. "Fact is, you reset that expensive computer so it should make those expensive robots stand idle. Why not leastwise use them for Solar?"

"That would have ruined relations with the natives, sir. Primitives don't take blandly to the notion of technological unemployment. So scientific studies would have become impossible. How then would you attract personnel?"

"What personnel would we need?"

"Some on the spot, constantly. Otherwise the Baburites, close as they are, could come back and, for example, organize and arm justly disgruntled Suleimanites against us Robots or no, we'd soon find the bluejack costing us more than it earned us . . . Besides, machines wear out and it costs to replace them. Live native help will reproduce for nothing."

"Well, you got that much sense, anyhows," van Rijn rumbled. "But why did you tell the computer it and its robots should attack *any* kind of machine, like a car or spacecraft, what comes near, and anybody of any shape what tells it to let him in? Supposing situations change, our people can't do nothings with it now neither."

"I told you, they don't need to," Dalmady rasped. "We get along—not dazzlingly, but we get along, we show a profit—with our traditional arrangements. As long as we maintain those, we exclude the Baburites from them. If we ourselves had access to the computer, we'd have to mount an expensive guard over it. Otherwise the Baburites could probably pull a similar trick on us, right? As is, the system interdicts any attempt to modernize operations in the bluejack area. Which is to say, it protects our monopoly—free—and will protect it for years to come."

He started to rise. "Sir," he continued bitterly, "the whole thing strikes me as involving the most elementary economic calculations. Maybe you have something subtler in mind, but if you do—"

"Whoa!" van Rijn boomed.

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"Squat yourself. Reel in some more of your drink, boy, and listen at me. Old and fat I am, but lungs and tongue I got. Also in working order is two other organs, one what don't concern you but one which is my brain, and my brain wants I should get information from you and stuff it."

Dalmady found he had obeyed.

"You need to see past a narrow specialism," van Rijn said. "Sometimes a man is too stupid good at his one job. He booms it, no matter the consequentials to everything else, and makes trouble for the whole organization he is supposed to serve. Like, you considered how Babur would react?"

"Of course. Freelady Vaillancourt—" *When will I be with her again?*—"and Drs. Bergen and Nakamura in particular, did an exhaustive analysis of materials on hand. As a result, we gave the computer an additional directive: that it warn any approaching vehicle before opening fire. The conversation I had later, with the spaceship captain, or whatever he was, bore out our prediction."

(A quivering snout. A bleak gleam in four minikin eyes. But the voice, strained through a machine, emotionless: "Under the rules your civilization has devised, you have not given us cause for war: and the League always responds to what it considers unprovoked attack. Accordingly, we shall not bombard.")

"No doubt they feel their equivalent of fury," Dalmady said. "But what can they do? They're realists. Unless they think of some new stunt, they'll write Suleiman off and try elsewhere."

"And they buy our bluejack yet?"

"Yes."

"We should maybe lift the price, like teaching them a lesson they shouldn't make fumblydiddles with up?"

"You can do that, if you want to make them decide they'd rather synthesize the stuff. My report recommends against it."

This time Dalmady did rise. "Sir," he declared in anger, "I may be a yokel, my professional training may have been in a jerkwater college, but I'm not a congenital idiot who's mislaid his pills and I do take my pride seriously. I made the best decision I was able on Suleiman. You haven't tried to show me where I went wrong, you've simply had me dismissed from my post, and tonight you drone about issues that anybody would understand who's graduated from diapers. Let's not waste more of our time. Good evening."

Van Rijn avalanched upward to his own feet. "Ho, ho!" he bawled. "Spirit, too! I like, I like!"

Dumfounded, Dalmady could only gape.

Van Rijn clapped him on the shoulder, nearly felling him. "Boy,"

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the merchant said, "I didn't mean to rub your nose in nothings except sweet violets. I did have to know, did you stumble onto your answer, which is beautiful, or can you think original? Because you take my saying, maybe everybody understands like you what is not wearing diapers no more; but if that is true, why, ninety-nine point nine nine percent of every sophont race is wearing diapers, at least on their brains, and it leaks out of their mouths. I find you is in the oh point oh one percent, and I want you. Hoo-ha, how I want you!"

He thrust the gin-filled goblet back into Dalmady's hand. His tankard clanked against it. "Drink! Drink!"

Dalmady took a sip. Van Rijn began to prowl.

"You is from a frontier planet and so is naïve," the merchant said, "but that can be outlived like pimples. See, when my underlings at HQ learned you had pulled our nuts from the fire on Suleiman, they sent you a standard message, not realizing an Altaian like you would not know that in such cases the proceeding is SOP," which he pronounced "sop." He waved a gorilla arm, splashing beer on the floor. "Like I say, we had to check if you was lucky only. If so, we would promote you to be manager some place better and forget about you. But if you was, actual, extra smart and tough, we don't want you for a manager. You is too rare and precious for that. Would be like using a Hokusai print in a catbox."

Dalmady raised goblet to mouth, unsteadily. "What do you mean?" he croaked.

"Entrepreneur! You will keep title of factor, because we can't make jealousies, but what you do is what the old Americans would have called a horse of a different dollar.

"Look." Van Rijn reclaimed his cigar from the disposal rim, took a puff, and made forensic gestures with it and tankard alike while he continued his earthquake pacing. "Suleiman was supposed to be a nice routine post, but you told me how little we know on it and how sudden the devil himself came to lunch. Well, what about the real new, real hairy—and real fortune-making—places? Ha?

"You don't want a manager for them, not till they been whipped into shape. A good manager is a very high-powered man, and we need a lot of him. But in his bottom, he is a routineer; his aim is to make things go smooth. No, for the wild places you need an innovator in charge, a man what likes to take risks, a heterodoxy if she is female—somebody what can meet wholly new problems in unholy new ways—you see?

"Only such is rare, I tell you. They command high prices: high as they can earn for themselves. Natural, I want them earning for

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me, too. So I don't put that kind of factor on salary and dangle a promotion ladder in front of him. No, the entrepreneur kind, first I get his John Bullcock on a ten-year oath of fealty. Next I turn him loose with a stake and my backup, to do what he wants, on straight commission of ninety percent.

"Too bad nobody typed you before you went in managerial school. Now you must have a while in an entrepreneurial school I got tucked away where nobody notices. Not dull for you; I hear they throw fine orgies; but mainly I think you will enjoy your classes, if you don't mind working till brain-sweat runs out your nose. Afterward you go get rich, if you survive, and have a big ball of fun even if you don't. Hokay?"

Dalmady thought for an instant of Yvonne; and then he thought, *What the deuce, if nothing better develops, in a few years I can set any hiring policies I feel like;* and: "Hokay!" he exclaimed, and tossed off his drink in a single gulp. ■

IN TIMES TO COME

Next month's issue introduces a new writing team—a "two-headed author" consisting of a husband and wife team, Richard and Nancy Carrigan. And they are genuinely a fully cooperating team, an ideal combination for working up science fiction. Dr. Richard Carrigan is a high-energy particle physicist; Nancy is a graduate journalist. And *they* can write science fiction.

"The Siren Stars" concerns the matter of receiving messages from the Stars—signals from Out There, sent by a culture having a higher technology.

Of course, the messages are beamed at *Earth,* not at the United States, or Russia or China or. . . .

Which first launches a certain amount of lethal espionage work, based on "he who gets the mostest the fastest wins the pot" philosophy. Computer technology being one of the most powerful of economic as well as military weapons, the science from the stars offers a very large carrot.

But the problem doesn't really become acute until the real price of the Song of the Siren Stars begins to appear! ■ THE EDITOR

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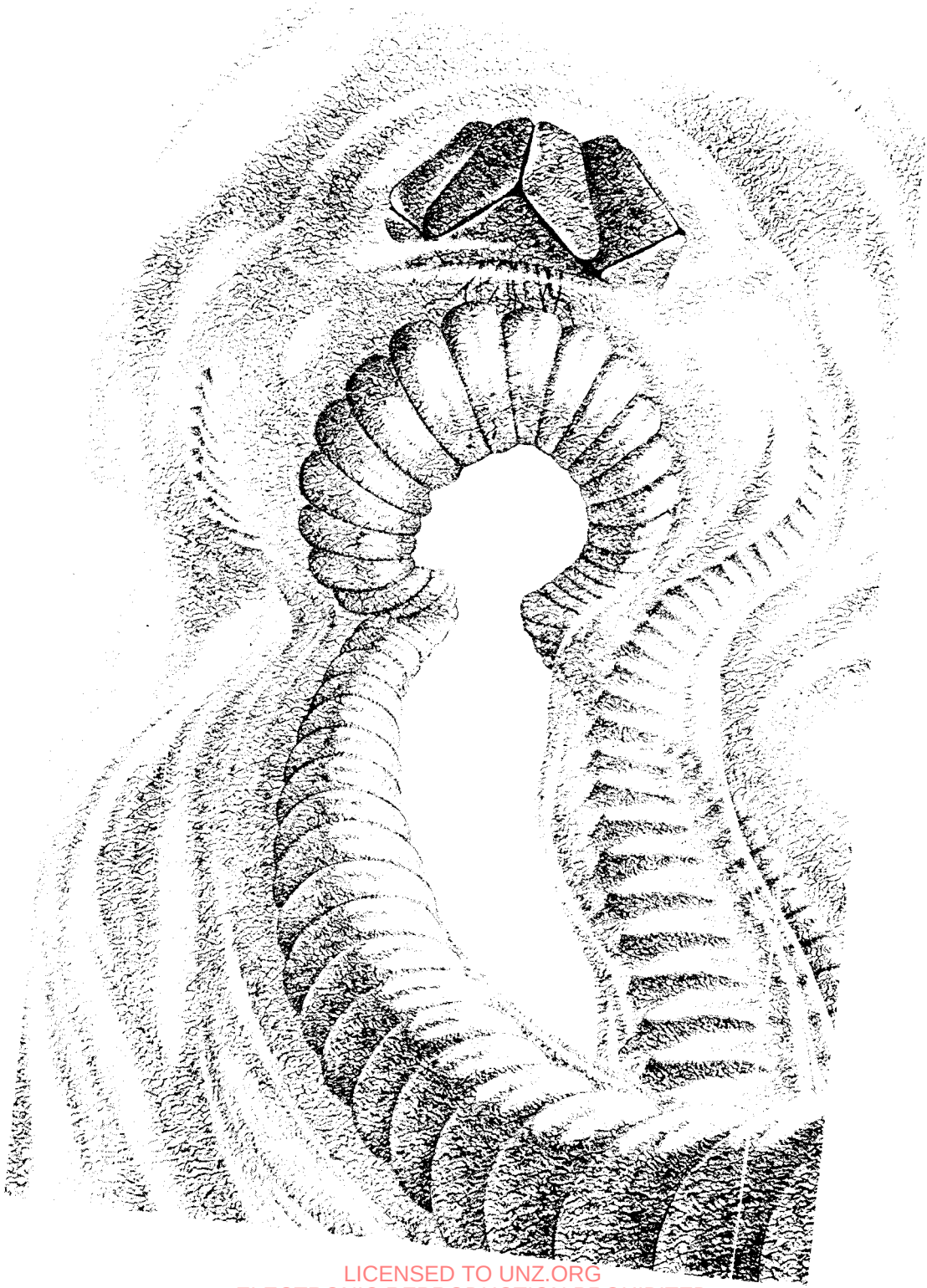

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DALI, FOR INSTANCE

In which it is pointed out that "a completely successful invasion" can be completely meaningless.

JACK WODHAMS

Illustrated by Peter Skirka

He opened his eyes and there were two of the strangest, ugliest creatures he had ever seen leaning over him. And everything was so bright and clear, it was weird. They were awful, bleached white oblong boxes with a most peculiar blob of head stuck up in the middle, and with white tubular appendages at each side.

Golec goggled. These were monsters, and they were alive! One moved one of its white tubes and he saw that there was a knobbly structure with booklike things sticking out the end of it. He felt it take hold of him. He gagged—the unfamiliarity was terrible. There were things happening to him that he could not comprehend, so many sensations unknown and impossible to grasp. He reacted purely by instinct. And the creature gripped a part of him and lifted that part in the air a short way, and Golec could feel it, could feel it and know that it was a part of himself, and he stared unbelieving, horrified, aghast. For what the creature was holding was a limb, an appendage, *his* limb—*and it terminated in a knobbly hooked claw just like the creature's own!*

Shocked and terrified at his indescribable metamorphosis, Golec screamed and screamed—and then mercifully fainted.

With dispassionate care they kept Golec sedated for a while, kept him in a state of apathetic nightmare. In waking moments his dope-dulled mind noted the passage to-and-fro of many of the creatures. From time to time the creatures tended to him, fed him through a tube—fed, that is, the creature's body that he had acquired. They bathed the body that was now his, and periodically accommodated the eliminating functions of his person.

Golec was revolted. Even when partially drugged he was disgusted by this totally alien housing that had claimed his awareness. He

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examined himself and touched himself and he shook his bloblike head in despair. He was like one of them, was as one of them, he *was* one of them. They treated him as one of themselves. And they were . . . *errgh!* so crude, so . . . so insect-like. And their sensing equipment was so odd, and their lighting so eerie, fluctuating from extreme darkness to an illumination that was staggering in its intensity. What an environment! The atmosphere was so thin that it was virtually nonexistent. Yet these creatures lived and apparently thrived under such circumstances. It was fantastic.

Gradually Golec assimilated his conditions and surroundings. This was it. He was trapped into one of these creatures. He had, for a while, to accept that fact. He had to try and get used to it. Given time he would get used to it. He shuddered. He remembered. He remembered himself as he used to be, remembered too well. What a fool. He would never adjust. But he *had* to adjust, to adapt. If he did not, he would never discover the means to escape, to get away, to return to his proper body. He had to find out what state the creature had been in to have drawn him into itself. And the only way to obtain that information was to behave as the creatures behaved—normally—as the creature's physique and sensing apparatus indicated.

The shock, the strangeness, the sickness that the creature's body evidenced to him only too well, took several days to wear off. The blind confusion in Golec's mind slowly gave way to calmer appraisal. This, after all, was an adventure. This, after all, was something that had been anticipated—not quite so devastatingly total in its difference, perhaps, but expected to a degree. It had been done. Golec remembered who he was and what he was, and initially he stubbornly over-clung to this memory, to the detriment of his recovery. But at last common sense and reason ordered his capitulation, and with diffidence he began to sort through the residual memories left behind in his host's brain.

Golec did not find a great deal and had not the necessary imaging ability to cull forth sequences. Nevertheless, he quite soon managed to understand the thought processes of this brain, to glean the basic motivations and the fundamental rhythm of the creature's intelligence. This made things a lot easier for him. The varied rasping chitterings of the creatures he began quickly to perceive as decipherable language, and his vague consciousness of meaning sharpened to a precise awareness of the import of the undulations, interruptions and inflections given to the sounds that the creatures used to one another and to him.

It was bizarre. To be in such a

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form, such a shape, such an alien body. He, Golec, had become another living creature, had become transformed into an unimaginably freakish design with a sentience completely unrelated to anything he had ever known. Such utter dissociation from any previous conception was overwhelming. For Golec the inconceivable had become the norm.

He would never get used to it, never. No, never. But he was alive. As hellish and diabolical as his condition and his surroundings seemed, so repulsive to his awareness, he *was* still Golec. He was alive and suffering, suffering not physical pain but the agonizing pain of an entirely disoriented psyche. But he was alive, and life has resilience, no matter what form it takes.

Golec became easier, more familiar, more relaxed, more able to be rational. His state was only temporary. He would escape back. It would take time perhaps, but that had been understood. The experiment, after all, had been primarily exploratory.

The creature's frame that Golec inhabited shivered. He would never get used to it, never.

"You've made excellent progress, Joseph," the psychiatrist said. "You have improved remarkably over this last week and your avid interest in reading and personal activity has been a refreshingly healthy indication of your regained sense of perspective. Very gratifying, I might say."

Joseph Kirkland, the name of the body that Golec had acquired, smiled faintly. What a stupid way to express a sentiment, to move little muscles in the face to distort its shape and thus by some alchemy convey a message of obliging alertness. Thank God the motor functions of this body seemed to operate automatically to achieve the desired effect.

"I feel fine," Golec offered helpfully. His early croaking attempts at speech had been dismaying, but a little perseverance and private practice had restored the facility that these creatures were accustomed to employ. What a curious formulation of vastly disparate utterances were used to transmit and inform!

"We are pleased with your response to treatment," the psychiatrist continued, "so much so that we feel confident that you will probably be better served now by taking a final couple of weeks recuperative rest at home."

"At home?"

"Yes." The psychiatrist beamed. Golec was not yet skilled enough to detect the patent falsity of such cheerfulness. "Your friends, your parents, have been delighted with the rapid advances you have made. You are sober and sane," the analyst wagged a finger, "overly reticent maybe, but I am convinced that your action was not

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deliberate but inadvertent, and that your consequent behavior was merely the manifestation of traces of the drug burning out of your system. I believe you," he said with staunch sincerity, "when you tell me that you don't know how you came to take such a quantity of the drug. An accident, a mistake that could happen to anyone. From my examinations there is no indication whatsoever that you are abnormal in any way."

"I . . . I'm glad to hear it," Golec said.

The psychiatrist resumed his benignity. "So we'll have to discharge you, I'm afraid, ha-ha. With our workload we can't clutter up the place with people who need no more therapy than their freedom, eh? So your friends have agreed to call for you this afternoon. That'll be all right, eh?"

Alarm shot through Golec, right to the ends of the oddly jointed digits at the ends of the cantilever arrangements that were known as arms. This moment he had dreaded. But he had to face it. Yes. He had to venture forth among them. They did not know who he was. As far as they were concerned he was one of them. And, although he did not care to dwell upon the thought, for the moment he really *was* one of them. "Good," he managed to say. "I'll be glad to get home."

But, he would never get used to it, never. By firm control and will power he had managed to largely deny the crazy unreality of the existence he had adopted. He lived in a state that for the sheer preservation of his sanity demanded that his suspensoin of belief be more or less constant.

"Yes, well, so you can pack your things and get yourself ready then, eh?" The psychiatrist stood up and came around his desk, and Golec stood up also to clasp the outstretched palm. "I don't think you'll have any trouble, Joseph, but if you do, if at any time you feel you need help"—a guiding arm fell upon Golec's shoulders, turning him, prompting—"you have only to come and see us here, or call. You know that, don't you?"

"Yes."

At the door Golec paused. An absurd formality. He was acting in a dream, had control of a grotesque living organism that displayed attitudes and responses in a way that bordered on the ludicrous. Had his situation not been so serious, his personal involvement so complete, he might have found the impossible illogic of this state of existence as being diverting, even if morbidly so, as perhaps the conjuring of *the* wildest of imaginings. But he was unable to take any such objective view, for the macabre element of undeniable actuality threatened upon acknowledgment to severely constrict the highly sensitive breathing mechanism of the housing he now owned.

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He had at all costs to maintain, if he could, normal creature behavior. Upon this his survival depended.

"Thank you, doctor. I very much appreciate the care and attention you have given me."

"We are, believe me, glad to have been able to assist," the medic answered. "I don't think you'll require our services any more, Joseph, but remember—we're always here if you need us."

"Thank you," Golec repeated.

And upon these amicable terms doctor and patient parted, and Golec was released into the world.

Golec wondered how the others had fared. What had happened to Sbol, Vundl, Hilc? Had they, too, arrived somewhere upon this highly improbable planet? Or . . . had they gone somewhere else? There was no way of telling. Could he hope to find them? Their pre-arranged plans to locate one another had not taken into consideration such an absolutely radical and unheard of life form such as this. How could they communicate? So far Golec had found nothing that in the least approximated the type of communication they had decided to employ. Everything, but *everything*, was entirely different.

It was positively frightening. They had been prepared, yes, for changes, for some environmental modifications, for novel constructions and conceptions, for some departure from physical similitude—but this!

Golec came back always to the incredible body now held by his conscious mind, the body that in turn held his conscious mind imprisoned to its sensing. Such things! Breathing, smelling, itching, hearing, seeing, the recording of feeling was astonishing in its complexity. And yet so many of what might be termed ordinary sensing capacities were either absent altogether or were gravely diminished. These creatures did not know what it was like to sherrz, and had no ability at all to indulge chunsyugle—they had no geewahs, no oons, and they were simply not equipped for it.

What a body. This atmosphere was so thin and this breathing business was so important that it worked involuntarily. It puffed by itself. So much of this creature functioned by itself. Made up of lengths of some sort of calcified material, with joints everywhere, the musculature was surprisingly efficient considering the awkwardness of the contraption.

But Golec would never get used to it. Never. The soft, spongy elasticity of the outer covering, and the way it became damply sticky when either mind or body was placed under stress . . . *ahhhk!* And the method of imbibing foodstuffs and, worse, disposing of waste, *eeyerrgh!* Golec shuddered. To permit himself to think about it overmuch was to occasion a

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loathing that led to despair. Already Golec had used his new peculiarly-placed eyes to read and scan pictures that delineated the construction of the human frame. His superficial inquisitiveness had soon been satisfied and, for the sake of digestive quiescence, he had not pursued the subject to any depth. If the outward appearance was unprepossessing, the inner contents that made up a human creature most certainly could not bear contemplation. Golec felt that he had been unwise to learn as much as he had. The stiff frame was hinged all over the place in order to give it some measure of pliability, and it followed, therefore, that the inner structure would equally be an improvised mishmash of components formed to cope as best they were able, to function with utility within prescribed limits. No, Golec shied from thinking, even fleetingly, about the insides that he had obtained.

Golec was collected from the hospital by friends of Joseph Kirkland. Two young women and a young man. They treated him with deference, and he was thankful for that. He dredged his host's mind for memory, but discovered only faint hints of association.

There was much in the mind that Golec had yet to understand, and there was much superimposition of self-identifying data that Golec required to retain. Fortunately a human creature's body was comparatively easy to handle. Reflexes were so attuned that the merest impulse could direct limbs and sections into motion with the minimum of conscious effort. Walking, which at first sight had appeared to be a distinctly clumsy and complicated means of locomotion that would demand fierce concentration, proved instead to be comparatively simple. The coordination ordered by the brain brought remarkably swift reaction, and even the small joints in the extremities could be manipulated with surpassing ease. The hardest part had been the mental leap needed to even attempt such eccentric exercise. For what it was, Golec had grudgingly to admit that the body had a certain measure of competence in directing its several interconnections to perform in accord.

Joseph's friends did not speak much but moved their facial muscles about in a manner that Golec had come to recognize as reflecting a disposition toward amiability.

Golec felt desperately lonely and lost. The kindliness of these creatures penetrated his self-absorption somewhat and, in all honesty, he reluctantly had to concede that they had a mutual regard for the condition of one another, and on the personal level could be most considerately attentive. It was as though, Golec thought, they might be subconsciously aware of the unlikely and incongruous figures they

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possessed, be intuitively alive to the implausible nature of their estate.

Golec was not called upon to make more than brief comments, and he allowed himself to be led and persuaded out from the building and, with masterfully concealed trepidation, into a transporting vehicle.

He was one of them. If they only knew! If they only knew who he was! But how could they possibly suspect? He was in their form, an identical model. How could they possibly detect his presence among them? From the outset they had evidenced not the least suspicion, not even initially, upon his arrival, when the first blunt impact of total horror had been paralyzing, had nearly deranged him, had left him open and hopelessly vulnerable to exposure. No. They suspected nothing. It was crazy. And it was all so unreal.

Golec deliberately dulled the perceptive edge of his mind. He dared not think about it too much. He had to think, yes, but constructively. He had to thicken his tnord that the overall impression might be slowed to be ingested more gradually. And he had to forget such integral necessities as his tnord for he no longer had one, his creature's body was tnord bereft. To lament the absence would be to nurture regret, to invite melancholy, to sink into despondency and open the hardly shut gates to insanity. He had to think, he had to accept, he had to adapt. He had no choice.

Golec sat in the back of the car and was driven "home." He went along with things, let things happen, learned and borrowed, was still glazed in some respect for the protection of his mind. He fought back slowly to defeat his sense of helplessness, to establish himself and adjust. He was Golec, a Byadja of the Sreberom. He was on a unique investigatory mission. So far, for him at least, the mission had been an astonishing and unequivocal success, an incontestable triumph.

Golec rubbed his hands. He stared at his hands. *His* hands. He shook as with chill. He would never get used to it, never, no, never.

It was Golec's unwitting good fortune to have assumed the physical attributes of Joseph Kirkland. He could have done a lot worse. Joseph Kirkland was a young man whose parents were quite well-off. Joseph Kirkland had been an art student, albeit a somewhat casual one it seemed, a person adequately catered to from indulgent family coffers.

Joseph Kirkland had his own apartment. One of the young women who had met him at the hospital apparently shared this apartment, but Golec soon became aware of what such association implied and blindly recoiled from the

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abhorrent notion. The very thought of such generative behavior Golec found repellent in the extreme. It was so . . . so . . . *ugh!* Eating was a necessary habit to acquire, and defecation was a function impossible to avoid, but . . . to perform, to become involved, to attempt to practice their corybantic and extraordinarily contactual mating ritual, oh no! No, indeed not, no, no, no. Golec had enough on his plate, thank you, and his sensing complex was overloaded at even the most mundane level of existence.

After a tense few days the young woman at last, with surprising lack of rancor, left Joseph Kirkland to the peace he seemed to desire. If he acted strangely, seemed rather withdrawn, well, after what he'd been through . . . If he wanted, she promised to return, as she put it, "when he had found himself again," an insight that troubled Golec briefly.

But Golec was given time and, continuing unassailed, his reconciliation to his circumstances proceeded apace, and his confidence grew to a point where his doubts and fears became displaced by a certain pride and arrogance. He could move among these unknowing creatures with impunity. He could manage Joseph Kirkland's body with a dexterity that many of the human creatures themselves could not match.

Joseph Kirkland's body, in fact, became a constant source of interest, often diverting when one capability or another became recognized to be fully appreciated. Smell, for example. It was a full month before Golec switched from a general consciousness of odor to a sudden acute awareness of the subtler differentiations. It was like ecshessing in a way, remotely, very remotely . . . for without wuwil pads the delicate tremulos couldn't be . . .

At such times Golec would sigh. But sternly he refused to let himself slide into pointless nostalgia. He had a job to do.

Golec gained in assurance and grew to marvel at the simple perfection of the technique that had enabled him to so easily insinuate himself directly into the society of these unbelievably alien aliens. It was incredible. So strangely developed from the most tangentially unheard-of origins. With time abating his distress, his fear of unmanageable confrontation faded. Golec settled, gave himself leave to wander abroad, unguarded his mind that it might probe further afield in questioning what was, after all, a fascinating experience.

As Joseph Kirkland, Golec cautiously returned to college. He was not queried. It was so easy. He even found himself being admired for possessing talent, for presenting a new and brilliant facet in his pictorial creations. Really, these creatures had perplexing values.

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And Golec met and studied humans and relaxed. Familiarity bred contempt.

Golec more and more considered ways and means whereby he might contact the others—the others of his kind. There was a good chance, wasn't there, that one or more would also have arrived upon this queer planet? And Golec badly needed someone to talk to, to discuss plans, to share notes, to compare experience. Having so splendidly survived the mind-shattering transition period, having tenaciously battled tremendous odds fighting the urge to capitulate, an urge to mentally surrender and collapse, having won through to be so magnificently infiltrated that his presence was in no wise apprehended—these things Golec longed to discourse upon, to communicate to a like mind. And a like mind in return would surely be pleased to apprise *him* of many things that he had yet to cognize.

Vundl, Hilc, Argt, Sbol—would any of them be here? Golec had to find out. So—he himself had translated his native meaning patterns into rough human-creature equivalent had he not? Of necessity much was lost in the effort of trying to transcribe incompatible media, but *somewhere, somehow* in the sounds and symbols of human speech, there had to be a compilation that would strike a chord of recognition in a mind that knew.

Names. Yes, names. Golec. Golec was the nearest he could get to expressing his own name in human-type language. Would the others, similarly human-bodies and endowed, would they connect the sound and letters of Golec with that of their old comrade? When they translated his name, would they translate it the same way? Or rather as Cloek? Or as Glowlick? Or, supremely endeavoring as Sgioefleschk?

Golec gritted his human-creature's jaw. He had to try. He would keep it as simple as possible. The chance was slim but he had to try.

The Kirklands, as has been said, were not notably restrictive toward their son. Joseph Kirkland's father was a major shareholder and vice president of a prosperous cake-mix and confections company.

Once having decided upon his bold plan, Golec nerved himself, prepared himself, summoned up his courage and determined to put it through. Golec had already had two jittery and uncanny encounters with his "parents." On both occasions he had been unconscionably wary, and most oddly affected in sentiment. This peculiar body that he owned was the direct reproductive result of these two disproportionate creatures who were in no way materially attached to him, but who yet regarded him with exceptional affection. In some way Golec had found meeting them a weird occurrence.

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But he had passed the test. They, of all humans, should surely have unmasked him. But no. Golec had discovered that silence and monosyllables provided acceptable fare, and that he could sieve enough entrenched solid from the cloudy memory deposits of his host to enable him to observe oft-repeated responses and to move about the house with some directional certitude.

Now, having carefully weighed all the evidence he could muster, Golec concluded that Joseph Kirkland's affiliation to his father, though abstract, was strong, sufficiently so that he, Golec, could influence and induce his "father" to perform a small favor. And he was right.

Golec was amazed how pleased his "father" was to accede to his request. His "father" indeed was enthusiastic over the idea as Golec had dressed it and applauded his "son" for the liveliness of his awakened interest, for his imaginative style and his coming to grips with life. Kirkland Senior was gladdened by his son's sudden definitive suggestions for business promotion and, as the idea presented was certainly no worse, and was in fact better, than much of the crud currently being employed, he agreed to sponsor the notion. Yes, and he promised not to alter a thing, not one word. He thought that the drawings were just great, just great. He was proud of the boy, proud, so grateful to see at last that his son was pragmatically realizing his true potential. He'd always known he'd had it in him.

Golec came away from the session satisfied but puzzled, and for the first time unwiser perhaps than he had been before. There was much he had yet to understand. He would never get used to it, not properly, not ever.

On television sets throughout the country commercial time was taken by a competition-note addition to the Hott-Kakes ad.

"A new set of eight great comic pages featuring Golec, a Byadja of the Sreberom in search of his friends Hilc, Vundl, Argt and Sboi. Kids, don't miss this—collect the set and coupons and when you put all eight together it'll tell you what to do. You'll get surprises from the prizes, and remember—you get one page and one coupon with every packet of Hott-Kakes Ziprise, No-Knead-Do, Kwikflaps or Kool-Ease . . ." And so into the jingle, "Don't wire, dear. I'll bake the cake when you get here. No trouble. No trouble. No trouble . . ."

For Golec it was a long shot. He could think of nothing less dramatic that might spread his message so repetitiously over such a wide area. He hoped against hope that somewhere his message would be read and interpreted as he intended, that somewhere within the range a mind correlated with his

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would thankfully know that he, Golec, was here.

"It was a billions-to-one chance," Nylm said. He belched. He wore the rather corpulent frame of a master stevedore named Patrick McCurlin. "Fact is, I very nearly didn't follow it up—but I was curious."

"What?" Golec was startled. "Surely not! Surely you must have been delirious practically to make contact with one of your own kind again? *I* was. When I got your letter, I couldn't wait to get here!"

"Ah." Nylm sniffed. "Sure you don't want a drink?"

Golec declined. Nylm carefully poured himself another glass of root beer. "Yes," he said. "What for?"

"What for?" Golec was nonplussed. "Why, to . . . to . . . to be united, that's why. We're not the same as these creatures, are we? We're different. We're from another world. We're from a different society, from an entirely different cultural development. We're not . . . Good heavens, did you ever in your wildest dreams conceive a place like this? Could you ever in a most frantic moment of aberration have visualized things, animals, of . . . of becoming the creature that you have? It's . . . it's stunning! To actually be forced to concede that we are here, that we are conscious, that this is actually real and not a fantasy. I tell you, there are times when I still fear to go out of my mind."

"Mm-m-m." Nylm studied the froth on the top of his glass. "Yes, it was a bit of a shock first off. I was in a daze for almost two weeks before I managed to start acclimatizing. Even so it's funny how quickly you get used to it."

"*I'm* not used to it," Golec declared. "I don't think I ever could get used to it."

"Oh-ah." Nylm took a gulp. "Well, you'll have to make the effort, won't you?"

"What? What do you mean? Schlydles, you don't think we're going to stay here forever, do you? We have to go home, we have to get back. What we have learned here is of tremendous importance."

"Uh huh." Nylm slopped a fat tongue around his lips. "And how do you propose to go home again? By what means? There's no expanser unity receptors here, although the concept will doubtless crop up in some local form sooner or later."

"We can probably get home again simply by getting into the condition that these," Golec grimaced, "bodies were in when the exchange took place. They're at home now on standby, just waiting for us."

"Why haven't you tried to go back then?" Nylm asked mildly.

"Why?" Golec felt uncomfortable. "Apparently the dominant force of this body caused what

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could well have been a fatal overdose of a drug substance to be imbibed—pills they call purple hearts. For my first days here I was looked upon as being suicide-prone. Which, as it turned out, happily covered my extreme distress at that time."

"Yeah, I see." Nylm thoughtfully sucked in some more root beer. "So you don't want to load yourself with more purple hearts because one: Those at home might fail to reel you in, in which case two: You could very well go, uh, hm-m-m—vlipht!"

Golec nodded. "Exactly. It's something of a dilemma. Not that I lack faith in those at home," he added hastily, "but leaving home was a lot less ambiguous than a sure return augers to be. It's one of the vital things I want to talk over with you."

"Yeah," Nylm said again. "Do you know how I came by this body? Golec, it was stinking rotten drunk, that's what. You were lucky. Me, I woke up in the tank. A nightmare, oh boy! I never want to go through that again. Though like you, I got medical treatment and this helped some. By the time I dried out I was almost in fit enough shape to take my place in this nutsy society." He wiped his mouth. "If you want to loosen your libido, alcohol will make you available in safety."

"Ah, now that's interesting," Golec said, his eyes agleam. "Now *that* is a very useful thing to know."

"Is it?" Nylm said. "I'm not so sure. I take great care not to get drunk these days."

"But why?" Golec was surprised. "Don't you want to go home?"

"Not particularly," Nylm replied with some indifference. "Maybe I'd think about it if I could be sure of getting my original plasm back. But that's unlikely. Have you thought about it?"

"Of course. My plasm is there waiting . . ."

"Is it?" Nylm gave a wry grin "The mind you presumably swapped with was suicide-prone, huh? How do you think he might have reacted waking up in your plasm? Huh? And my guy? And suppose they got used to it and liked it? And suppose they didn't want to leave?" He leaned his elbows on the table. "No. And on top of that you can bet that we're not the only ones who have taken an identification with the Allness, that one further step into united fluidity. You unshackle your mind again and you might, just *might*, return home into a bearably organized plasm. On the other hand, in my opinion, if you went you would most probably find yourself on yet *another* alien world, inevitably totally alien both to *our* world and to *this* world. No, no." Nylm shook his head. "I'm not going through something like that again."

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Golec paled. "But we can't stay here!"

"Why not?"

"Because . . . Because . . . well, it's not our world, is it? We don't belong here. We're aliens here."

"No we're not," Nylm said reasonably. "Basically, the daring idea that we volunteered to test was intended superficially to broaden our knowledge of the Universe—if successful. We understood ourselves to be spies, and it was implied that such broadened knowledge would lead irrevocably to insidious invasion to promulgate the supremacy of the Sreberom." He grinned. "Very juvenile, really. Our plasm couldn't survive here. The way the human animal has developed this planet, its usefulness to plasm is virtually nil. While knowledge of the place might be of incalculable interest, no description given could be adequate, and even an approximate description by us would certainly be regarded as an exaggeration and be discredited as a traveler's embroidered fabrication. Who'd believe *us* if we told them about *this?*"

Golec had picked up the bad human habit of biting his nails, and he chewed a nail now.

Nylm demanded. "How could we prove where we'd been? *If* enough of us got back, maybe . . . But the chances are slim. The risks are too great. If, as I suspect, there is other traffic out there, perhaps under better control than ours, then God alone knows what may have claimed the receptive plasm, if any, prepared for us."

"I . . ." Golec was not at all willing to face such unpalatable contingencies. "We *have* to get back! I am a Byadja! And so are you. We are *not* human creatures!"

Nylm contemplated him. Slowly he began to shake his head. "We are individuals. You are Golec. I am Nylm. This is a constant, no matter what form we may take. As plasm, we could not even start to hope to exist on this planet. So to invade this world the Sreberom would be compelled as we were to assume the highest form adapted to the conditions, right?"

"Yes, but *we* know, don't we?"

"We become humans, can't you see that? The form is merely a vehicle. We cannot invade as plasm —but to become humans defeats our purpose, doesn't it? What could we hope to achieve? To live here we need the human design, lunatic as it is, in order to survive. To exist here, sensibly, we have to *be* humans, reproduce as humans, conform as humans."

Golec plainly found the thought distasteful. "Even in this shape I am Golec."

"You're human now," Nylm said simply, "and you can't prove otherwise. Go out and tell them who you are. Go out and tell the police, say, where you come from and how you came to be here. Huh! You know what'll happen? They'll laugh

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at you and say you're a nut."

Nylm displayed his proficiency of human expression with an eloquent shrug. "You've got nothing to show. You're obviously human. Look, when I woke here I just went to pieces—I gibbered, gabbled. Golec, I was a pitiful defenseless wreck. They were unimpressed, you know that? I was just a guy with the d.t's. And cranks here, believe me, are so commonplace. There is so much toleration of variety—it's another thing that makes me think that types from all over the cosmos might come here."

Golec was consternated. "You've no justification for saying that!"

"Our conceit," Nylm said. "Why should we think we're the first? There're plenty of humans here who suddenly do strange things, turn over a new leaf, or for no apparent reason radically change their behavior."

Golec was aghast at the suggestion. "They can't all be . . . be like us or . . . or be other aliens."

"Why not? Some of them anyway. What can they do? If they rave, they get put away. It doesn't take much intelligence to realize that the sensible way is to play it cool and go along. It works both ways—if we can't prove we're not human, then neither can they."

"But I . . . I don't want to be trapped in this crazy state for the rest of my life."

"Oh, it's not so bad." Nylm sat back and nonchalantly draped an arm over the back of his chair. "There are compensations."

A woman entered the kitchen. She nodded and smiled at Golec, turned her attention to Nylm. "Excuse me. Pat, honey, could you tell me what you did with the back half of the paper?"

"Oh yeah. Think I might have left it in the bedroom. Sorry, Mit."

"O.K." She smiled and left.

"What, uh . . . Just who is she?" Golec asked.

"Mit? She's my wife, who else? A great woman, great. You know, I used to be nothing but a drunken bum. She's a lot happier these days now I stay sober."

"I . . ." Golec was at a loss. "You can't be serious? To have gone so . . . ik, all-embracingly native?"

"What else is there to do? So by a freak you've made contact with me—what about the rest? How can you find them? They could be in China or India. Or somewhere in Eridanus, or Lyra. And if you found them, what could you do? Try and conquer the world? What for? Just to change plasm into individual humans who are individual already? What would be the point? No, no. See, there's another thing, the key—those at home don't *need* us back. They've got samples that they *know* are samples. Treated right and lovingly oriented, they'll get all the information they want, won't they?"

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Golec searched his mind for a comforting answer that was surely there somewhere, but could find nothing. This last gave him that terribly empty sensation that comes from a feeling of being had. The selection, the secret testing, the esprit—dispensable. "We've been betrayed."

"Not badly," Nylm said. "We were picked for our integrity. It's just that they didn't labor the unattractive possibilities, that's all." His smile was philosophical. "Being a human isn't so bad. It's different. The change is so . . . so absolute. There's variety and interest and something new at every turn. It's marvelous." And in a burst of frankness, "Candidly I like it. It's a vital life, so fresh—not dull and boringly familiar like it got back home. Human sensing is terrific, don't you think so? The way they see, and hear sounds, and touch. And their sex life is great, isn't it? No having to wait eleven interminable oppoldwons . . ."

Golec was dismayed. "You don't mean to say . . ." He trailed off.

"It's one of their sayings, 'If you can't beat 'em, join 'em, and it's the best thing to do, Golec. You can hide in a corner, you can risk trying another shot. But why not let yourself go, why not take it? You'll soon get used to it and *want* to be like everybody else. Forget Sreberom. You're disconnected now. Let yourself be human. You're not Golec now, you're Joe Whatsit. Be what you are. It can be a helluva lot of fun—Joe."

"Fun?" Golec said weakly.

"Sure, fun," Nylm repeated, breezily now. "I'm branching out shortly—little project of my own. Golec . . . Joe, you must see, you *must* feel—the change, the tempo. It's being born again."

Golec was not persuaded. "A lot of the humans I've met have not been exactly wild about being humans," he observed.

Nylm laughed. "That's because they were born humans and don't know any different. Few of them are enthusiastic. Sometimes I think that those who are most enthusiastic might be others like us. Honestly Golec . . . Joe, I've grown to like being human," Nylm confessed. "In fact I'd go so far as to say that to really enjoy being human, you have to be an alien."

Golec looked down at himself. Human. Him? Could he . . . really, could he get used to it? He'd purposely refused even to consider such a thought. But . . . yes, perhaps. No. Well . . . maybe. True, if permitted, the inexhaustible novelty . . . Ugh.

"You're lucky—young, reasonably provided," Nylm said. "You could go places here, be somebody."

And Golec scratched his now not-so-strangely bony skull. In newly admitted wonder and in some awe, he appraised the revelation of the obvious. "You know," he said, "you may be right . . . Pat." ■

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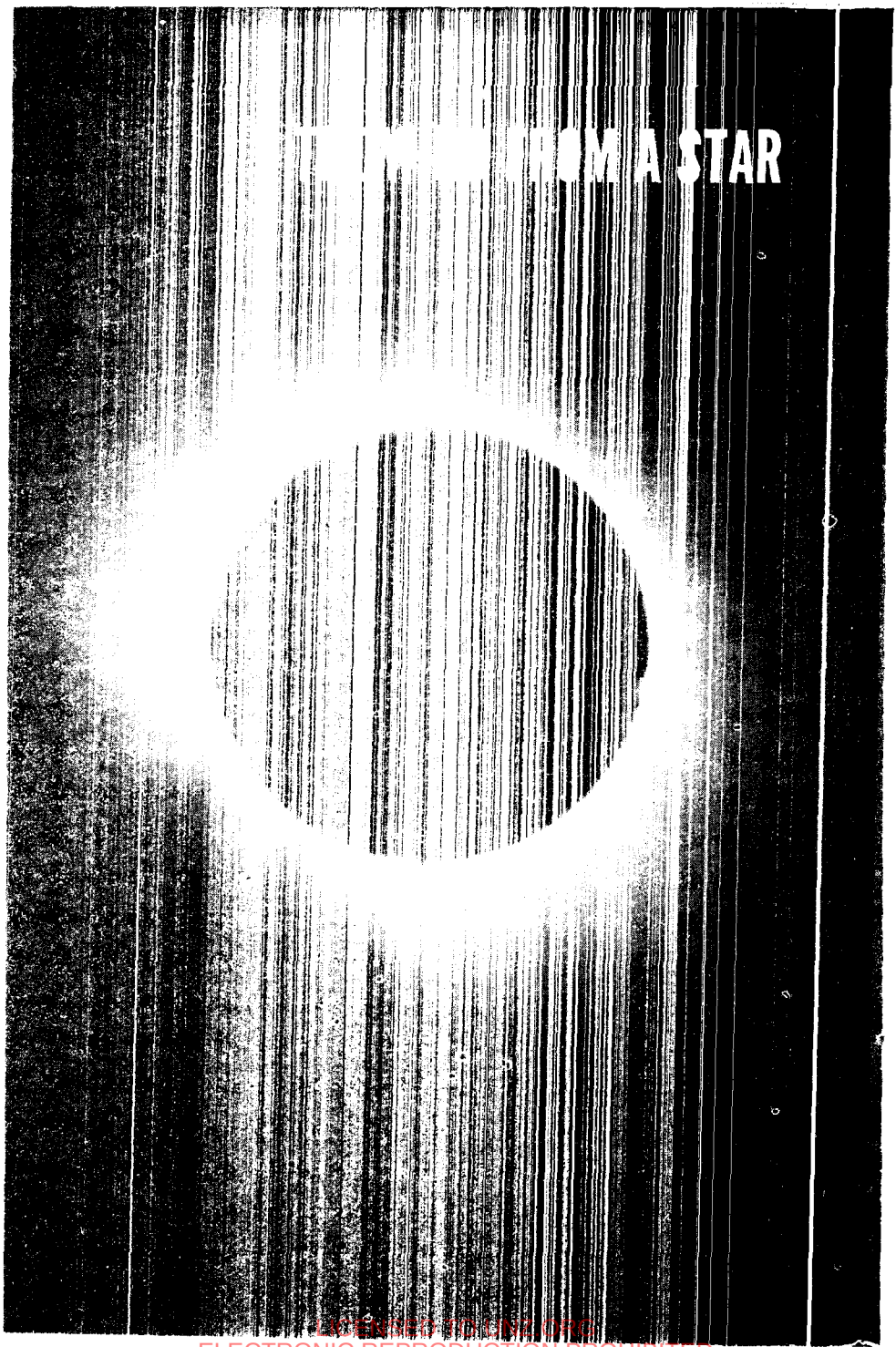

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The ancient idea of
"the wind that blows between the worlds"
turns out to be for real—but the old boys
never considered a 750,000 mile-per-hour gale!

MARGARET L. SILBAR

In a sense, the earth does not revolve around the sun but moves through it. The solar corona, unlike our own atmosphere, fills most of the solar system. It is, moreover, an expanding atmosphere that near the sun is moving outward, slowly at first, but attaining supersonic speeds at larger distances.

The expanding corona is at this point called the solar wind. Near the earth it constitutes a steadily blowing wind of hydrogen plasma that whips around us at 330 kilometers a second—about 742,500 miles per hour. As it blows, it collects the miscellany of space: meteoritic dust, cosmic rays, and gases which have evaporated from comets.

The solar wind often leaves magnetic storms and the aurora borealis in its wake. It erodes the lunar terrain and it probably even affects our weather. It is always there and probably has been, since even before the invention of death and taxes. Solar flares, or storms, and the activity of sunspots—called "flying birds" by the ancient Chinese—may bring about brief bursts of speed in the wind—up to 800 kilometers a second. Other times, the wind speed may drop to a low of 250 kilometers a second, but the wind continually sweeps the solar system.

In the olden days when the sun was young, the solar wind may have been more active, thus speeding the sun along the scale of stellar evolution. Since other stars may have their winds as well, this leads to an exciting—and completely speculative—picture of the universe: stellar winds streaming away from stars, contributing to their development, and to that of an interstellar wind as well. But this picture will probably be verified only after we have come to a fuller understanding of the solar wind.

The existence of a solar wind had long been suspected, but it was not until 1959 that we were at all sure there was one. The Soviet moon probe, Lunik II, brought back the first tentative confirmation of the wind. Later measurements by Lunik III and our satel-

May 30, 1965, Solar eclipse totality showing prominences, solar brushes, and coronal light distribution typical of minimum sun spot activity. Small spot at top is Jupiter.

Los Alamos Scientific Laboratory, W. H. Regan

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lite Explorer X backed up what Lunik II had found. But astrophysicists tended to distrust the data from these three craft since in each case it was collected over the very short period of about one day. It was the 1962 data from Mariner II which proved the existence of the solar wind to everyone's satisfaction.

The Vela satellites, first sent into orbit in 1963, have shown that the solar wind contains oxygen ions as well as electrons, protons, hydrogen and helium atoms. The proportion of helium to hydrogen in the solar wind is, according to Vela data, about four percent on the average. If this average indicates the *solar* abundance of helium, it is an embarrassment to some of the "big-bang" and nucleogenesis cosmological theories, which predict the helium abundance as around ten percent.

The *idea* that the sun spews out something other than light dates back at least to 1892 when suggestions began to be heard linking "solar corpuscular radiation" with comet tails, magnetic storms, and the aurora. It was a Norwegian physicist, Olaf K. Birkeland, who noticed a resemblance between the, to him familiar, aurora borealis—"northern lights"—and the electric discharges in cathode-ray tubes.* Birkeland proposed that the sun shot out electrically-charged "corpuscular rays" which were sucked in by the earth's magnetic field near the poles, thereby causing the aurora. Birkeland was a highly imaginative man and one of his more imaginative suggestions was, essentially, that of a continuous solar wind: ". . . almost at any time pencils of electric rays from the sun are striking the earth."

While Birkeland was working on his auroral hypothesis, the Irishman, George F. FitzGerald—now remembered mostly for the Lorentz-FitzGerald contraction—and the Englishman, Sir Oliver J Lodge, turned their attention to comet tails. They attributed the strange fact that comet tails turn so they always point away from the sun to particle radiation emanating from sunspots and "projected from the sun with an average velocity of about 300 miles per second." Not bad for a first guess!

The suggestions of these three pioneers never really got fully baked. Nonetheless, they are important historically since they introduced a new line of thought, that there was something other than light streaming from the sun. Geomagneticians came to accept the idea of "solar corpuscular radiation" as an article of faith, as an explanation of geomagnetic storms —the storms which jiggle compass needles and induce currents in telephone wires and telegraph cables, blowing fuses and causing other

*They were new then, but they are TV tubes today.

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damage.* But scientists in other fields scoffed.

In 1951, Ludwig F. Biermann began pushing the idea of a *continuous* solar wind to explain the behavior of comet tails. He estimated the repulsive force acting on them by considering the acceleration of matter in the gaseous comet tails necessary to turn them away from the sun. In the case of a Type I comet tail, this force was found to be of the order of two hundred times that of the sun's gravitational force. This disproved an earlier hypothesis that the electromagnetic pressure of light was responsible, for such pressure could not exert a repulsive force greater than a few times that of the sun's gravitational force. Biermann suggested this acceleration was due to the momentum transfer from solar wind electrons.** Biermann's comet-tail research indicated that the solar wind must be streaming away from the sun continuously in *all* radial directions, rather than coming in bursts from sunspots—the Lodge-FitzGerald hypothesis—or from solar flares. Comet tails can thus be thought of as "interplanetary wind socks."

Biermann's work was ignored until 1958. Then, at a time when the idea of a solar wind was distinctly out of favor, E. N. Parker pointed out that Biermann's solar wind thesis fit in very well with a simple hydrodynamic expansion of the solar corona. According to Parker's model, the corona, the sun's outermost layer, is continuously exploding. As the corona expands outward from the sun, it travels faster and faster until, finally, it reaches supersonic speeds, and, at this point, Parker called it the solar wind. At the time, the only good evidence supporting Parker's hypothesis was the behavior of comet tails.

The solar wind's parent, the corona, has turned from one of the least to one of the better understood features of the sun in the last three decades. Until the late 1800s, we knew little about it other than what Plutarch had told us in talking of solar eclipses: "there always appears around the circumference of the sun some light that does not permit total darkness." Kepler had got us off the track for over two centuries by attributing a corona he saw in 1605 to the moon's atmosphere. It took us a while to learn that the moon does not have an atmosphere.*

In 1898, the astronomer, E. S. Maunder, came up with a photograph which sets the limit of the visible corona at 15 solar radii

*A typical geomagnetic storm contains as much energy as 100 to 1,000 lightning strokes; one lightning discharge releases about 10^{20} ergs a second.

**This explanation is now considered incorrect. The acceleration is explained as a gross plasma and magnetic field interaction between the wind and tail.

*It is this lack of atmosphere, together with the lack of a magnetic field, which causes the lunar surface to fall prey to the solar wind.

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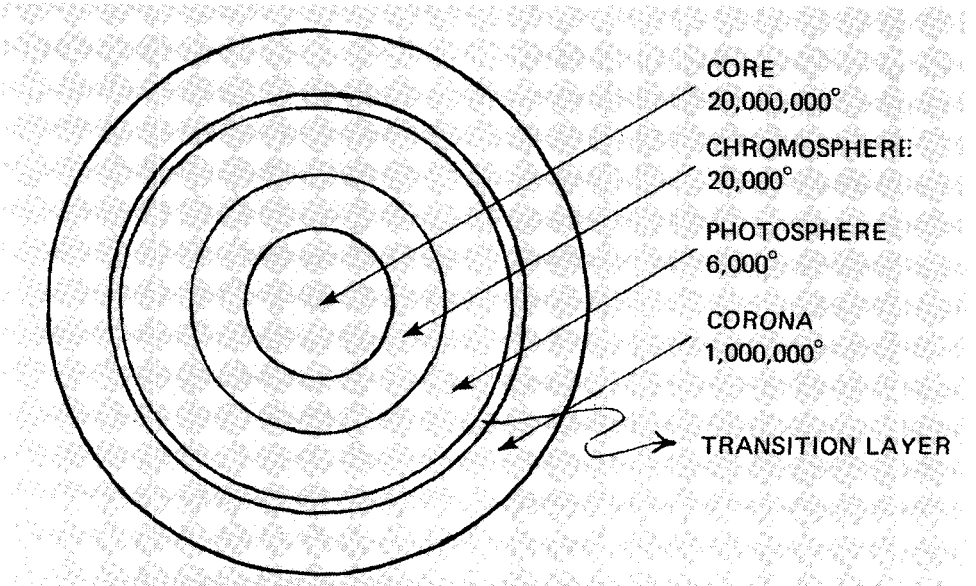

Fig. 1. The layers of the sun.

from the sun. The corona is visible because its atoms scatter light coming from the photosphere, the shiny part of the sun. Maunder's photograph was one of the few solid pieces of data gathered before the second world war that did not lead to confusion.

One of the confusions, an annoying coronal mystery, involved its spectrum, the light given off by its glowing atoms. This spectrum, apart from its hydrogen lines, defied identification, and a new element with very peculiar properties was postulated. In the early forties, however, the Swedish physicist, Bengt Edlén, showed that this new element "coronium" was a myth. Most of the lines in the strange spectrum, he said, come from a mixture of rather common elements, but of a highly ionized species, not seen before in earthly laboratories. "Coronium" is a combination of iron, calcium, nickel, and argon—hence, the corona's nickname, the sun's "iron crown."

Highly-ionized atoms are atoms whose electrons have all or nearly all been torn off by high temperatures, and such atoms are thus a clear sign of intense heat. The corona is indeed hot: the ionization

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state of the solar oxygen seen near the earth indicates that the inner corona has temperatures ranging from one to three million degrees. The temperature, moreover, must rise from 6,000 degrees near the visible surface to a million degrees in the very short distance of 500 kilometers.

The idea of a hot corona was slow to catch on for it was aesthetically disturbing to find that the corona was significantly hotter than the photosphere, the sun's visible surface. The photosphere, in turn, is cooler than the sun's core. (See Fig. 1). One astrophysicist quipped that "the familiar laws of nature are set at naught in the corona." He was referring to the fact that none of this jibes, at first thought, with the second law of thermodynamics which says that unless somebody is performing the necessary work, heat always flows from a hot body to a cooler one, never in the opposite direction.

This high coronal temperature is one of the most remarkable features of the sun, and astrophysicists began puzzling out the "why" of it back in 1945. But, even now, there are no theories which answer all the questions. What theories there are hinge on the corona's "tenuousness." The corona is not very dense; it is about 10^{-16} times less so than water, about as dense as the very best vacuums that men can make in laboratories. Because of its thinness, it takes very little heat to raise its temperature, perhaps one-millionth of the sun's total energy output. There are two kinds of theories to explain where the corona might get its heat.

The "accretion theory," which says that the sun captures interstellar particles as it travels through space, was a historical first guess, which has had a recent revival. The reason behind the revival was the discovery that the corona is far richer in iron than the photosphere. A possible source of iron is meteors, which are often composed of iron and nickel. Apparently, the sun might capture meteoritic dust in highly elliptic orbits around the sun. According to this theory, the sun not only snags the particles directly in its path, but it also manages to gravitationally capture those with hyperbolic orbits, otherwise destined to escape the solar system. As all these particles are absorbed into the coronal gas, their large kinetic energy, or energy of motion, becomes the energy which heats the corona.

Theories which suggest that the corona is heated by a part of the sun's interior called the "hydrogen convective zone" are more popular at the moment. Such theories say that the churning of the gas beneath the sun's surface produces low-frequency waves, which may be magneto-hydrodynamical in nature. The surface of the sun can be thought of as roaring with turbulence, and the energy in these

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waves is absorbed by the coronal gas and turned into heat.

Hannes Alfvén showed experimentally how such waves might originate in the interior and travel to the surface. While gases in the solar interior are under great pressure and may be denser than ordinary liquids, Alfvén had no choice but to work with a liquid. He chose mercury because it is the only one of the common liquids which is a good electrical conductor.

In his experiment, Alfvén used a small mercury-filled tank with an agitator like that of a washing machine in the bottom. As long as there was no magnetic field present, the slow oscillation of his agitator had no effect on the mercury's surface: the molecules slid by one another so that the motion died away. However, when he applied a strong vertical magnetic field of 10,000 gauss to the tank the fluid "stiffened" and any motion at the bottom was quickly

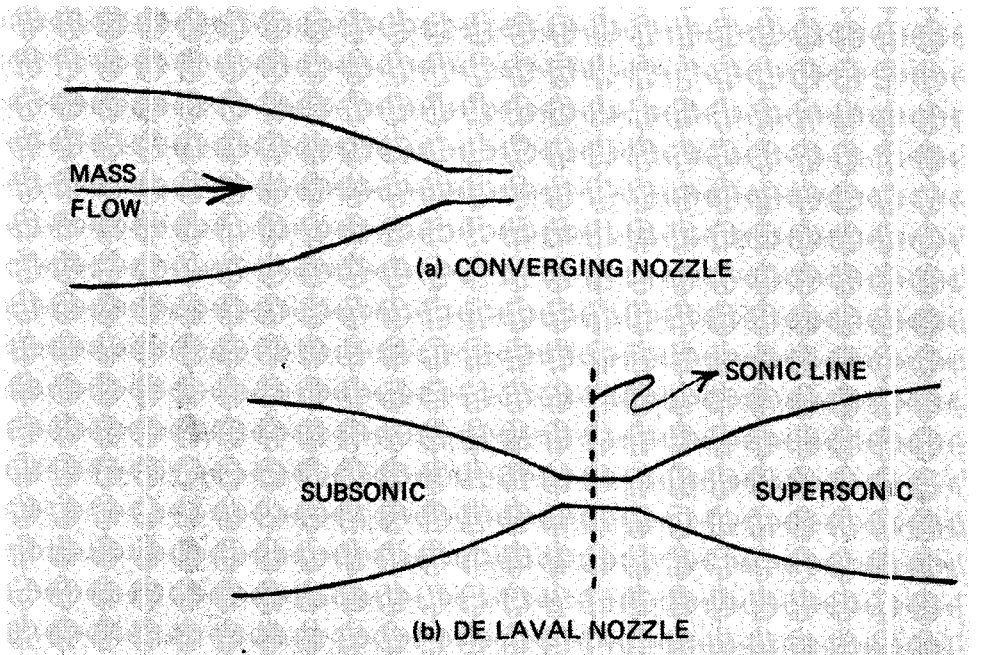

Fig. 2. The addition of a diverging section to (a) allows supersonic streaming velocities as in (b).

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carried to the top. The motion is carried by a particular kind of magneto-hydrodynamic wave now called an Alfvén wave.

The sun's general magnetic field is much weaker than the one in this experiment, being estimated at about one gauss. But theory tells us that if the vessel were larger, such waves could be produced with a far smaller magnetic field. Thus, an Alfvén wave could, for example, be generated by the motion of spicules—spicules are the tongues of gas on the chromosphere's surface—in the sun's field.

Close to the sun, the corona is almost the static layer we once pictured it as. Then it begins to move away from the sun despite the fact that the average thermal velocity of the coronal particles is less than the gravitational escape velocity—615 kilometers a second. The corona expands all the while because the particles' pressure is greater than that of the outlying atmosphere. It moves sluggishly at first, traveling at about the speed of sound in air. It takes some five days to go a million kilometers. But by the time the corona is ten million kilometers from the sun—six solar radii—it is expanding far faster than the speed of sound—and its temperature is dropping.*

To understand how the solar wind attains supersonic speeds, we can turn to nozzles. The mathematical equations describing the hydrodynamic expansion of the corona are similar to those for the flow of gases through deLaval nozzles,* the nozzles on which rocket engines are based. The mass flow in a converging nozzle, shown in Fig. 2a, is subsonic everywhere in the nozzle. This picture changes if we add a diverging section to the nozzle in Fig. 2a, turning it into the de-Laval nozzle of Fig. 2b. What started out as a subsonic flow will become a supersonic flow, so long as the downstream nozzle end opens into a vacuum. It is the sun's gravitational force which chokes the flow, forming the "throat" of the nozzle and allowing a supersonic wind to develop.

Our model for the hydrodynamic expansion of the corona now presents us with what seems to be a contradiction. The observed solar wind particles have been traveling at speeds from 250 to 800 kilometers a second by the time they reach the earth. If we were to plug in all the numbers in the mathematical equations describing an adiabatic expansion of the corona—i.e., an expansion of the gas without heat being added—we would find that the speed the wind would have at the earth is 290 kilo-

*By the time the solar wind reaches the earth, the Vela measurements show its temperature is down to 50,000 degrees. Despite this high temperature, there is so little heat content in the tenuous solar wind that we earthlings are unbothered by it.

*DeLaval was a French engineer who owned a cream separator factory and who developed this nozzle for his separators.

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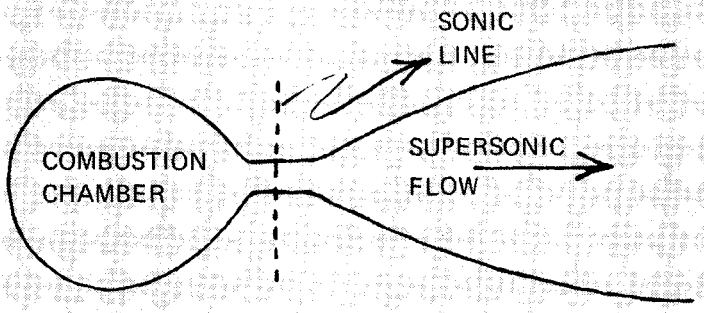

Fig. 3. In a rocket engine, the engine turns the disordered thermal motion into ordered streaming motion. The streaming motion depends only on the temperature in the combustion chamber.

meters a second, which is about right. But this calculation does not allow for the decelerating force of the sun's gravity.

Somewhere, the wind must pick up additional velocity. Astrophysicists surmise that the "afterburner" principle is pumping energy into the gas as it expands non-adiabatically. In a rocket engine, shown schematically in Fig. 3, the engine simply changes the disordered thermal motion in the combustion chamber into ordered streaming motion. The streaming motion depends *only* on the combustion chamber temperature—just as the solar wind velocity depends only on the coronal temperature.* If we wanted to further speed up the flow from the rocket engine, we could heat the gas after it passes the sonic line and after it has started to cool off by expansion. This is the afterburner principle.

Once thermal energy is added beyond the critical point—the nozzle throat is estimated at three solar radii from the sun—it can be converted into streaming energy. A simple calculation indicates that the major share of the solar wind's energy must indeed be added beyond the throat. Suppose by the time a solar wind proton reaches the earth, it is traveling at about 450 kilometers a second, corresponding to a kinetic energy of 1.1 keV.** (One keV is the energy that a particle with one charge, a

*A doubling of the temperature would cause a thousandfold increase of the gas flow speed near the earth.

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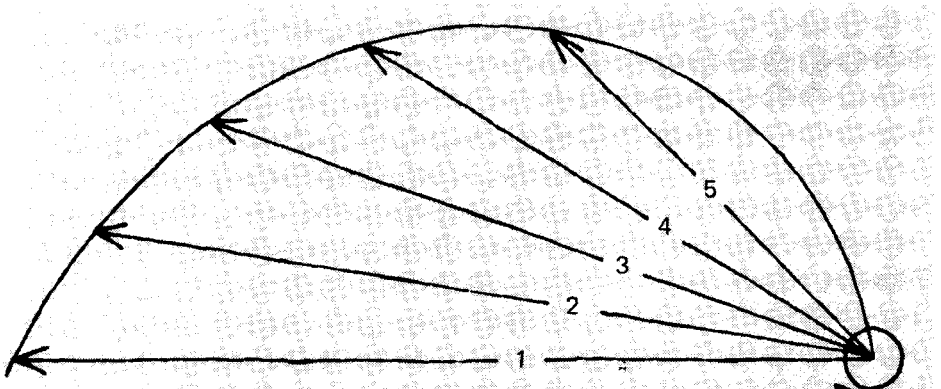

Fig. 4. Solar wind particles move radially away from the sun during a five-day period, but the sun's turning causes the locus of a line of moving particles to lie along an Archimedes spiral.

proton, for example, gets in falling through a potential of 1,000 volts.) The proton used up 2 keV in pulling away from the sun's gravitational field. At the earth, each proton has a total energy, i.e., a kinetic plus potential energy, of 1.1 keV + 2 keV = 3.1 keV. Yet it began its journey away from the million-degree corona with 0.3 keV of thermal energy. Somewhere, it picked up the difference, 2.8 keV.

If most of this heating were not, in fact, done beyond the throat, the coronal temperature would rise, forcing the throat back closer to the sun. This model places an upper limit on the coronal temperature—if its temperature were greater than four million degrees throughout, the corona would expand subsonically.* Astrophysicists have calculated that if the coronal temperature is to remain constant, only about 0.1 keV can be added in the three solar radii out to the throat. The other 2.7 keV must be pumped into the plasma after it becomes a supersonic wind.

It is not really known where this energy comes from. One possible way that heat can be added to the solar wind beyond the critical point —where it goes supersonic—is via the solar wind electrons which can conduct heat outward from the

**The electrons start with the same energy as the protons, but after the plasma turns into the solar wind, the protons carry almost all the flow kinetic energy. The energy in the streaming of the electrons is negligible, a mere 0.5 eV. Why this happens is far from understood.

*If, on the other hand, the corona were too cool, the solar atmosphere would be static, as is our own atmosphere.

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corona. This may come about because the random thermal speed of the electrons is much higher than the flow speed of the solar wind.

Another possibility is shock waves, or sharp pressure discontinuities, which travel through the plasma and somehow dissipate their energy. One reason astrophysicists expect this is what may happen is that geomagneticians have already used the shock concept in explaining magnetic storms. Magnetic storms arise quickly, in ten minutes or so. If the solar wind were an ordinary, but tenuous, gas, this would be quite hard to understand since shock waves propagate through ordinary gases because of collisions between molecules. In this case, the wave front has a "thickness" at least as large as the distance that a molecule must travel on the average before it hits the next one. For a gas as thin as the solar wind, this distance is quite large—of the order of 50 kilometers—and the wave front is somewhat fuzzy and undefined, contrary to what is expected of a shock wave with a rise time of ten minutes.

The resolution of this conundrum is that the solar wind is not an ordinary gas, but a plasma with a magnetic field. In such a special fluid, a shock wave can propagate without molecules banging each other—what is called a collisionless shock. Using this picture of magnetic storms, astrophysicists suggest that the solar wind may be teeming with collisionless shock waves which pump energy into the wind. Near the earth, shock waves are very rarely seen in the solar wind and then usually following a large solar flare by fifty or sixty hours.* It may be possible that many more weaker shocks propagate out through the corona heating the solar wind, but dissipating before reaching the vicinity of the earth.

Under normal circumstances, the solar wind should deplete the corona in a matter of hours. But it doesn't. Apparently, the chromosphere, the layer of the sun beneath the corona, infuses the corona with a never-ending supply of new gases. A relation between this mass output and the amount of power needed to maintain the solar wind—or any other stellar wind—is given by a formula based on conservation of energy,

$$\dot{L}_M = \left[G\frac{M}{R} + (U_\infty - U_\odot) + \tfrac{1}{2}v_\infty^2 \right] \frac{dM}{dt}.$$

Simply, the formula tells us that the energy provided by the sun is equal to the potential energy of gravitational binding that must be overcome, less the amount of internal energy the gas loses when it cools because of its expansion, plus the wind's kinetic energy. For the case of the sun, the three terms in this power equation contribute 5×10^{27}, 1×10^{26}, and 2×10^{27} ergs/sec, giving a total energy out-

*A solar flare is a truly violent explosion, releasing 10^{33} ergs of energy, the equivalent of 25 billion megatons of TNT.

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put in the solar wind of 4×10^{27} ergs/sec. This is a million times smaller than the solar light output of 3.9×10^{33} ergs/sec. To get these numbers, one must know the rate of mass loss, dM/dt, which is about 0.4×10^{-13} solar masses per year, or about a million tons of hydrogen a second. Over the sun's whole lifetime, this amount of material is pretty negligible; it is a mere .01 percent of the sun's mass. At this point, the mass loss through the solar wind is no longer affecting the sun's evolution. This may not be the case with other stars, however, for some apparently have mass-loss rates as great as ten million times the solar rate.

We have already indicated that the solar wind carries a frozen-in magnetic field with it. The wind's intimate connection with its magnetic field is a complicated interdependence, whose mathematical description involves nonlinear equations which are well-known, but nearly insoluble. The wind's high temperature, as mentioned previously, leads to its ionization, to its atoms being stripped of nearly all their electrons. There are enough electrons to balance the positive charges—one per proton, two per helium ion, six or seven per oxygen ion, et cetera. Even though there are more electrons than protons in the solar wind, it is nevertheless a neutral plasma. One of the interesting properties of a plasma, as opposed to a more conventional gas, is that it can carry a magnetic field along with it. The solar wind is a magneto-hydrodynamic fluid.

As various bits and pieces of the solar wind leave the sun, they travel away radially. The net effect, however, is somewhat different because of the sun's rotation. The locus of the particles coming from a particular region of the sun near its equator will lie along a curved path, or Archimedes spiral, much as a stream of water comes from a revolving lawn sprinkler.* This is shown in Fig. 4, where the wind spewed out on the first day has been moving away from the sun for five days, that emitted on the second day for four days, et cetera.

The point of this is that the sun's magnetic field lines are trapped by the flow of the plasma in such a way that a field line emanating from this region of the sun is stretched out along this same Archimedes spiral, as in Fig. 5. All the sun's magnetic field lines take such spiral shapes, and, what is more, the spirals themselves co-rotate with the sun. At the same time, the solar wind continues to move radially outwards. An analogy is a needle on a phonograph record: the needle moves radially at a more or less constant velocity while the spiral groove rotates as a rigid body.

*The equatorial outflow of the solar wind seems greater than the polar outflow.

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The spiraling magnetic field lines are often thought of as being divided into "sectors." Some of the sectors contain magnetic field lines leaving the sun and some contain those returning to the sun. The solar wind can be thought of as pulling out the magnetic field lines to distances far beyond the earth, but eventually, the field is returned. Thus, the net amount of magnetic field lines which leave the sun is, as required by Maxwell's equations, zero.

The electrons, protons, helium ions, and magnetic field are all traveling outward together with a common bulk speed. The particles have random thermal motions superimposed on the common bulk speed. The thermal motions of the heavy protons are small compared to the bulk speed so that the net effect is an open spiral path. The thermal speeds of the electrons are high compared to the bulk speed so that, although the electrons are moving outward with the common

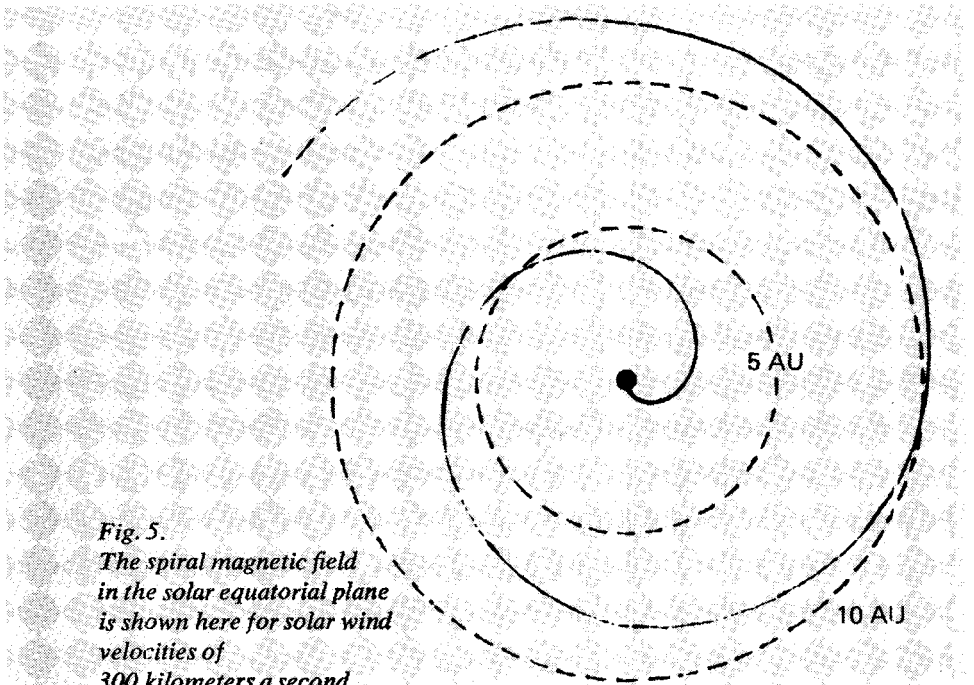

Fig. 5.
The spiral magnetic field in the solar equatorial plane is shown here for solar wind velocities of 300 kilometers a second.

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bulk speed, the apparent trajectory of an electron is like that of a drunken sailor somewhat randomly walking away from a lamp post.

It is primarily "drunken" electrons which impinge on our outer atmosphere, giving us magnetic storms and auroral displays. The electrons which cause auroras have much higher energies than the run-of-the-mill solar wind electrons. No one knows how the solar wind electrons are energized, how they get into the auroral regions, or how much time elapses before a given solar wind electron ultimately ends up producing light in the top of the atmosphere.

The interplanetary magnetic field also sets a lower limit on the solar wind's speed. For those parts of the solar wind which are very slow, the interplanetary field coils them up so tightly as to choke off their flow—that is, it traps the slow outgoing particles. In this way, the magnetic field prevents stable

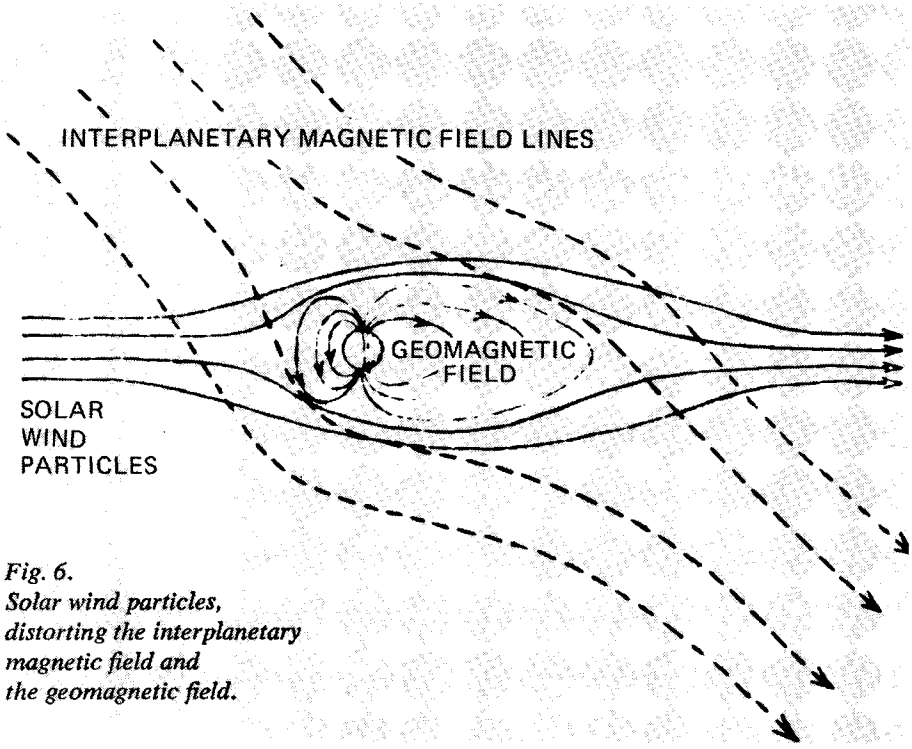

Fig. 6.
Solar wind particles, distorting the interplanetary magnetic field and the geomagnetic field.

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solar wind velocities of less than 100 kilometers a second.

Once it reaches the earth, the solar wind flows around the earth and the geomagnetic field, rather than running into them. (See Fig. 6). As a result of its intimate relationship with the interplanetary magnetic field, the solar wind particles act collectively as a fluid, albeit an extremely tenuous one. The particles flow around the earth in much the same way that air flows around an airplane wing. This analogy can be carried one step further to explain the distortion of the interplanetary field. One can think of the earth as a supersonic aircraft which sets up—yet another—shock wave along its advanced edge. This shock twists the interplanetary field out of shape as the solar wind carries it around the earth.

The solar wind also ruffles the earth's magnetic field, giving it a shape quite unlike the symmetrical one usually shown in textbooks. The geomagnetic field, shown in Fig. 6, looks rather like a teardrop with a long tail. The pressure of the solar wind squashes the geomagnetic field closer to the earth on its sunlit side, while the field on the dark side streams behind the earth for millions of miles.

As the wind passes by the earth and out into space, it becomes still thinner. In our neighborhood, the solar wind density is estimated at 0.1 proton per cubic centimeter. Apparently—though this is a far from settled question—the solar wind density decreases as the inverse square law and, eventually, the solar wind will no longer be able to push out into the more vacuous interstellar medium. At some point, the pressure of the solar wind will equal that of the interstellar medium. This balancing will end with the solar wind going through a shock transition to a subsonic flow. The solar wind will not immediately merge with the interstellar medium, however, for it will take at least a year for the wind's particles to break away from the sun's magnetic field—which then returns to the sun.

Astrophysicists have done a lot of talking about *stellar* winds, but here no one really knows anything. As Einstein was fond of saying, "experiment is the alpha and omega of theory," and the problem is the scarcity of data to form and check theories about stellar coronas and winds similar to our sun's. The best—if not the only—way to study a hot corona is to live in one—as we live in the sun's—and that is presently a hard proposition for other stars. Rockets may, of course, eventually remedy this situation, but until then, our second best chance to learn more about stellar coronas is to photograph one during an eclipse by a dark companion star, also a hard proposition.

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Nothing keeps us from playing a theoretician's number game, however. The number of stellar coronas can be estimated, depending on the theory of a corona's origin. Using the accretion theory, almost all stars are candidates for hot coronas. The coronal size would vary with the star's speed and the density of the interstellar matter the star is passing through. The coronal temperature would be set by the gravitational potential at the star's surface, and, if it were hot enough, a stellar wind would perhaps develop.

Exchanging the accretion theory for the more popular ones attributing hot coronas to energetic processes within the stellar core gives us a smaller number. All cool hydrogen stars would presumably have coronas. Extensive coronal heating—such as in the sun—would depend on a star's having a general magnetic field and a hydrogen convective zone to agitate the field.

Astronomers know that stars in spectral classes hotter than F—hotter than 7,500 degrees centigrade—probably have only thin convection zones. Meanwhile, stars cooler than 7,500 degrees have deep convection zones—and probably more stellar wind activity. Knowing only this, we can speculate about the comparative temperatures of coronas—cooler stars should have hotter coronas, relative to their overall energy output, than hotter stars. Thus, the stellar wind of one of the brightest stars in the sky, Rigel—of class B—would be likely to carry away a smaller portion of the star's energy output, than, say, the M-type supergiant, α Herculis. (M stars are the coolest of all, having temperatures of 2,200 to 3,500 degrees centigrade.)

So far, so good. Observations tell us that α Herculis and its visual G-type companion have a circumstellar envelope in common and that matter is streaming away from this envelope at the very slow rate of about ten kilometers a second. Yet the mass loss from this binary system is about 10,000 times greater than that from the sun.

The low velocity of α Herculis's wind is obviously not the supersonic expansion of a million-degree corona. And our hypothesis that cooler stars will have hot coronas seems to break down. There are two possibilities. Either the corona is too hot, leading to a subsonic expansion, or the stellar wind of α Herculis is not of the same breed as the sun's. Evidence for the latter possibility comes from the fact that the escape velocity from a giant star is quite low: million-degree temperatures are not at all necessary to produce a wind. In fact, astrophysicists speculate that a coronal temperature of three hundred degrees may be sufficient.

As mentioned earlier, stellar winds may also play a role in the

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evolution of an interstellar wind. A stellar wind could, for example, eject as much as ten percent of a star's mass back into space. The present interstellar density supports such a hypothesis, for the amount of matter in interstellar space represents only about five percent of the mass of each local star.

Space vehicles have taught us most of what we know about the solar wind's behavior and we must know even more about this and other stellar winds because of space travel. A brief solar wind gust, with its heavy protons—having energies of up to 100 MeV—could, for example, penetrate the suit of a man in space. Such protons are probably generated at a different level than ordinary solar-wind protons Perhaps they arise closer to the photosphere and chromosphere while ordinary solar wind protons come from farther out where some gravitational settling is going on. Nonetheless, energetic protons represent a very real danger to space travelers.

On the other hand, the solar wind might be a useful thing for space travel. There have been suggestions that the solar wind could be used for sailing ships. The first person to bring up the subject of solar sailing was a man from Akron, Ohio, with the pseudonym of Russell Saunders.* He suggested in the early Fifties, in this magazine, that solar photons, the quantum packets of light energy, could be reflected from magnesium foil sails —aluminized mylar was not yet on the market.

Photon sailing is not like ocean sailing where there is a keel and an interface between two fluids, both necessary for tacking into the wind. Nonetheless, in photon sailing, there would be some amount of directional choice for, while one has to go more or less downwind, it is possible to choose a direction by setting the sail.

It would seem to be an improvement, as in comet tails, to use the larger momentum transfer obtainable from the solar wind. Its constituent particles, however, would only allow sailing strictly downwind since they would not bounce from the sail, but would stick to it. The difference between the two kinds of sailing can be seen by analogy. Photon sailing is like bouncing a light bullet off a glass mirror—the sail—while proton sailing is more like throwing a heavy ball of putty at the same mirror. The putty ball sticks and thus, the momentum is transferred only in the direction the putty is going. In this case, this means radially away from the sun. At first glance, it seems as though it would be possible to avoid this problem by charging up a conducting surface and bouncing the charged protons from it using Coulomb repu-

*As a name, this is a kind of joke for spectroscopists.

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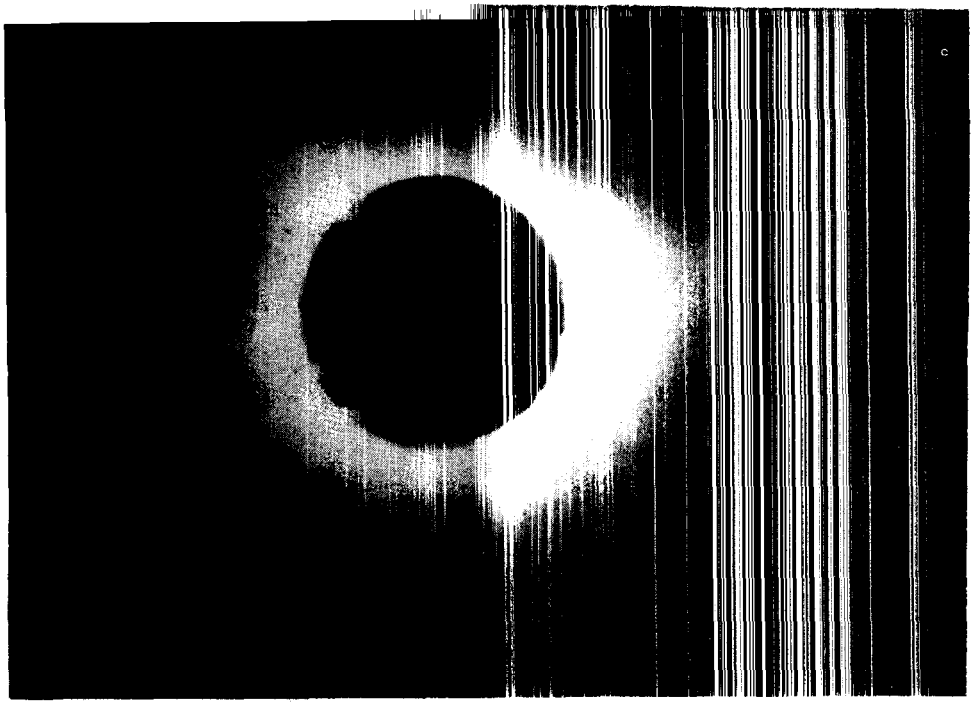

Los Alamos Scientific Laboratory, John McCloud

Solar Eclipse, November 12, 1966—Photographed during a total solar eclipse when the disk of the sun is obscured by the moon, the solar corona, a hot (T = 1,000,000 deg.) and tenuous (= 100,000,000 atoms per cubic centimeter), plasma becomes visible. Regions of activity on the solar surface are indicated by the light spots around the dark lunar disk and are related to the rays and streamers extending above them into the solar corona. Magnetic fields extend from the solar surface out into the corona and are carried outward by this expanding plasma as it becomes the solar wind. In the corona the magnetic fields appear to determine the shape and occurrence of the coronal streamers.

sion. But, since the solar wind plasma is electrically neutral and a good conductor, the charge on the conducting surface would soon be drained away.

Both kinds of sailing are, moreover, complicated by the fact that you have to contend with the gravitational attraction of the sun and the fact that you would start out in a given orbit with an angular momentum which must be conserved. You might be able to take advantage of these things to return to your starting position—for example, it may be possible to "sail upwind," by furling your sails and using the sun's gravitation. ■

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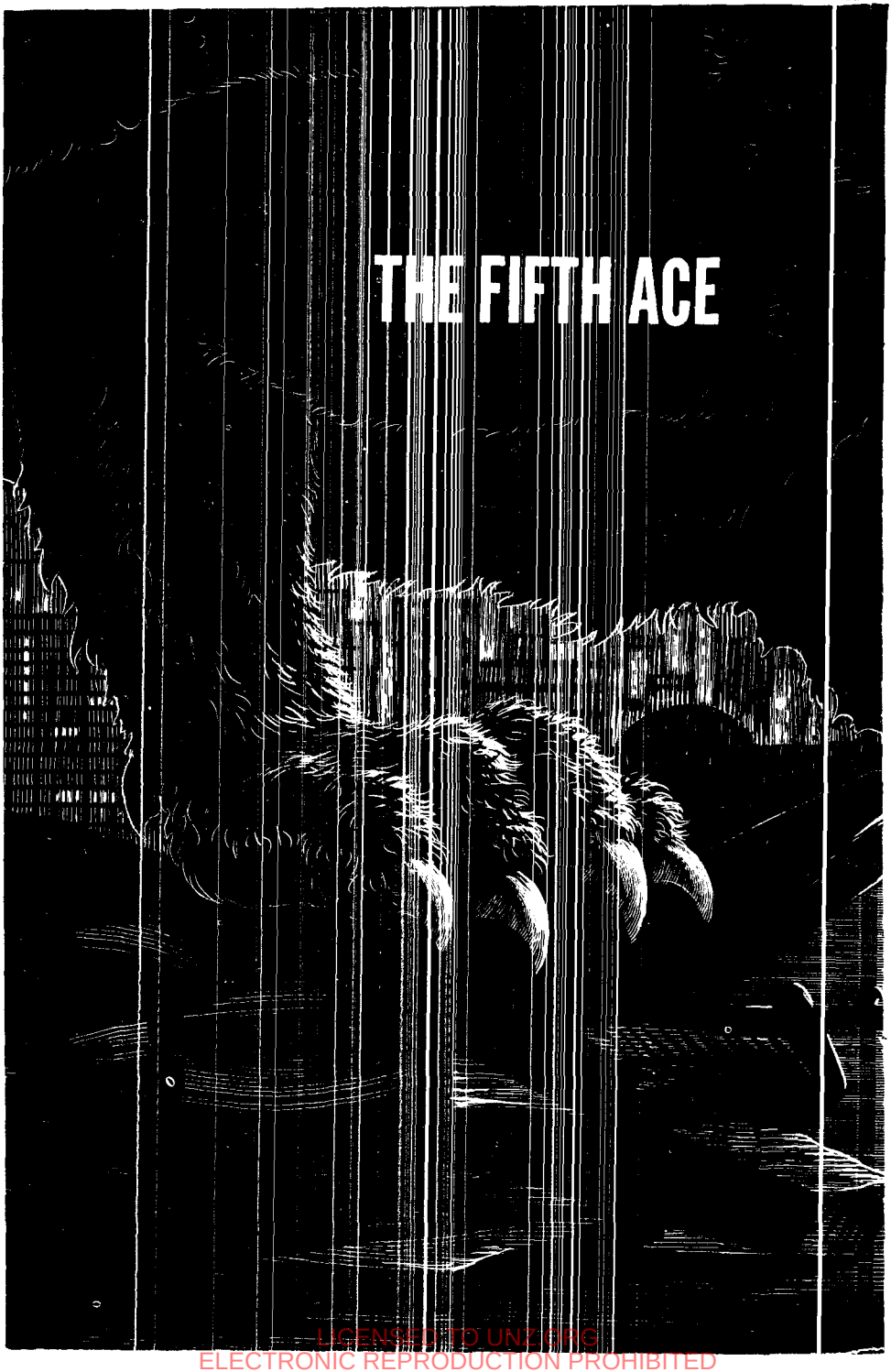

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A threat is something that appears dangerous; a menace, on the other hand, may be unnoticed—appear unimportant.

ROBERT CHILSON

Illustrated by Kelly Freas

The spaceport on Hyperica—the only one—was an odd mixture of very ordinary functional domes, cargo-robot hangars, docks, secondary shipyards, and the like, straddled and surrounded by the soaring towers of the Space Administration, luxury hotels, and office buildings. It was three miles across or more, supplemented by orbital skydocks in which major repairs and ship-building were done, as well as much of what meager business there was. Captain Wilnson of the Imperial Correlation Service was always wryly amused at the contrast between the functional parts of the port and those archaically magnificent towers.

They were not smoothly soaring conventional buildings; their facades were broken by great oval ports many stories tall, by flying balconies supported on upward-curving buttresses of crystal that could have been hand-carved quartz, or synthetic diamond, or just robot-cast transpex. Balconies, ports, windows, penthouses, roof towers, and similar addenda combined to give them a wild, fay appearance from any angle, but he privately thought that, like the Realm's philosophy, they were overstated, exaggerated. The Empire boasted many buildings as beautiful; much more so, as they need not be so self-consciously magnificent.

The contrast of the port was not so pronounced from near the tops of those towers; some of them almost a mile in height, and the little three-mile port merely seemed a blot in the luxuriously green forest that rolled out to the horizon.

Seen from closer up—or down—it was not grim, merely functional. Far beneath one of the Realm's Archons, of course; Cap-

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tain Wilnson was secretly amused at Ronnel Alpha Sharn, Subatar of the Sixth Cycle's utter blindness to the crassly bustling commerce all around him as he stood on the floor of the dock. Around them were numerous piles of freight; the robots would not dispose of it much before dawn. A little one-megaton transport had docked, one of the few Imperial ships permitted, under rigid regulations, to trade with the Realm of Man.

There were five great cages in a clear space between three such piles of shipping containers. In each was a gigantic cat, easily weighing half a ton. They were mottled in rain-forest-camouflage greens, dark green on top, lighter greens on the side, yellow-green underneath; darker than jungle-camouflage but still surprisingly bright-colored for such large animals. Their great square heads had two pairs of ears, one of them much smaller than the other and located close to the inner, upper corners of the latter. The ears were typical cat ears, the eyes equally typical, a glowing green with thick lashes behind which, nearly closed, they could be hidden. The nostril was single, a C tipped over on its face, and the ends curlicued into deep holes, though air was apparently taken in through the whole shape.

"They have an excellent sense of smell, Your Superiority," said Captain Wilnson when Ronnel mentioned this. "It is backed by large chambers lined with sensors."

"Of course." The Archon examined the mouth keenly, looked at Wilnson, who nodded. The mouths looked misshapen.

Wilnson stepped up to the cage housing the largest of the two giant males and put his hand slowly inside. The arborodon's ears, formerly at indifferent half-mast, came forward an inch and the eyes opened wider, though the massive head did not move. He extended his hand a little farther and the tassles on each of the two long tails flirted once. The lips writhed slowly back, ivory gleaming underneath. Along each side of the tooth row in the upper jaw was a flat blade of a fang, a great, curving saber a foot long around the outside of the curve, three-quarters of that in straight line. As it slid slowly down, another was revealed behind it, hinged perhaps the width of the large one apart from it—two inches. The smaller one was about two-thirds the size of the large one, identical in all proportions. The sharp edge was inside the curve so that pressure against it forced the blade forward against the stop rather than folding it up again.

Wilnson withdrew his hand slowly.

Ronnel's eyes lit; he stepped forward and actually bent a little at the knees and waist as he leaned

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forward to look into the cage in fascination.

"As you said, completely retractable. A most unusual animal."

"All of that," agreed Wilnson complacently. "The most highly-adapted arboreal carnivore in the known galaxy, largely because of its retractile fangs. Others there have been with hinged sabers, but none as efficient as this. Most of them were extinct before their planets were ever discovered; the fangs are just too clumsy."

The Archon waved all that aside as obvious, "Of course, of course." Wilnson reminded himself that the man knew more about zoology than he did. "But it takes more than retractile sabers to adapt an animal to the trees. Those bodies seem very blocky to be arboreal."

"True. As you have deduced, it has two vertebrae; the spinal cord is between them, deep under the back arches. Each back arch and its two ribs make a triangle of sorts —truncated; all ribs float for flexibility. But as you say, arborodons lack the sinuosity usually associated with highly evolved arboreals. Their relative shortness compensates. And . . ." he leaned forward again, watching the ears, and slid his hand into the cage just above the floor. The don ignored him irritatedly. His outstretched finger touched the pad of one enormous paw, applied pressure gently. The tassles flicked in annoyance, but a great hooked claw slid out. Fully extended, it would have been as long as his finger.

The massive head moved, the chin perhaps an inch, the eyes not as far; the don looked at him with dispassionate irritation. The ears did not lay back, though they flattened down closer to the head, but the negligently tilted paw turned gently back down to the floor of the cage. Wilnson moved steadily back from the cage, not too quickly or jerkily, and straightened up in relief. Even Ronnel took a step back; he knew animals.

"Beautiful," he murmured, glancing sidelong at the perspiring captain of Correlation. "A most noteworthy addition to my collection. Captain, you have more than verified your claim. Be assured that I shall take up the case of the Imperial Service with my colleagues of the Sixth Cycle."

"A part, merely, of my duty, *Your Superiority*," said Wilnson, concealing the sardonicism he felt. The Sixth Cycle was a level of influence in the Realm's upper ranks, not actually a part of the administration of the Archate—in which Ronnel held a much higher position than a level sixth down.

"How many such claws do they have?" asked the Archon.

"Four on each limb, with two shorter thumbs pointing forward. Those are for going down a tree head first. I have a record of one doing that, moving rapidly. An amazing sight."

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"I will require copies of all your records on arborodons, of course. Where do they originate?"

"A planet very nearly on the opposite side of the Globe, Your Superiority: Faerie, it is called. You may have heard of it as the origin of duocorns."

The other shook his head; Wilnson was not surprised. Standing here on Hyperica, they were three hundred light-years from Earth Faerie was half again that beyond it. Even Correlation Service knew only roughly how many inhabited planets there were in the Globe in the Eighth Century.

"Can they spend the night in those small cages?" asked the Archon, clearly satisfied with his first view of his new specimens.

"Oh yes; they were not shipped in them, of course; they've only been in them for a couple of hours. And they are familiar with cages, of course."

The giant male glanced at them for the first time, his fangs descending to full stop. His eyes half closed lazily, ears returning to neutral. In the lower jaw, two small ivory triangles beneath each of the four sabers leaned out and clicked together into V-shapes. These were the vestigial teeth that had matched the fangs before the latter developed into sabers; now they were whetstones. The jaw closed, the whetstones sliding up the great fangs.

Ronnel paused to watch interestedly. Wilnson was perspiring, knowing that the full—edited—record on arborodons had already been transmitted to the Archon's office. That was a sign of amusement, the dons' equivalent of a hearty laugh.

"That should be sufficient. I shall send men to supervise their moving; even without your warning I should not have been disposed to trust robots to do it. Early tomorrow morning, then."

One of the females, looking off toward the smear of green that was a glimpse of the forest, also began to whet her fangs lazily.

Arborodons have excellent night vision despite the fact that, unlike most large animals, they also have color vision. The night was not bright enough to trigger the latter, even with the port lights; not here between the piles of containers. The guards were aware that the dons were here, but had sensibly decided that no one would care to try stealing two and a half tons of carnivores, even carnivores raised in captivity.

As a matter of cold fact, they had not been raised in captivity, but on Faerie itself. Further, the great male that had attracted Ronnel's attention, Sky Hunter, had seen more planets than there were in the whole Realm of Man.

It was nearly midnight before he arose silently, almost invisible in the cage. He stretched, yawned,

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flicked his tails, looked lazily around. Four pairs of great glowing green eyes were fastened on him. It had been ten minutes or so since the guard had strolled casually by the cages, looking at them curiously. He rolled forward two paces and his lips peeled back. His sabers remained folded, but across the front of his square jaws were rows of teeth every bit as big as the fangs of more ordinary-sized carnivores; four of them in the lower jaw, three in the upper. They were as good as shears or scissors by themselves; used with the sabers, they anchored prey against the sweep of the great blades.

Now they closed on the gem-hard surface of the fist-sized lock.

The meteorite was big enough to make a considerable splash on impact, but was otherwise unimpressive; no larger than a large aircar, wagon model. It was metalliferous, judging by its radar reflection, roughly spherical, with a jagged appearance. The Realm's computers of Space Administration detected it early and computed its orbit; a near miss. Aside from the unusual orbit, there was nothing notable about it. It was approaching Hyperica from behind in very nearly the same orbit, so that its impact, if it had impacted, would have been the gentlest possible. They did not bother to track it all the way past, merely checking its position occasionally, just in case. They knew it wouldn't be back.

If a ship had been sent to divert it, they would have been surprised to find it not half so massive as it looked. Inside, it was hollow, and the hollow was nearly filled with a compact assortment of life-support mechanisms, including gravitronic plates to keep muscles from losing their tone during months of orbiting. There were air and water recycling equipment and an electrosynthesizer capable of turning out energy foods; proteins and vitamins were simply stocked, though the stocks were now nearly depleted. The couch contained exercising equipment and the robot that handled astrogation was linked to an extensive library. That was all.

The hollow was untenanted.

As the pseudo-meteorite made its closest approach to the planet, the robot computed velocities and times and, at the last moment, fed power to the gravitronic motors. Their gravito-inertial radiation was largely masked in the emission of the other ships just off the planet, and it happened that at that moment there was no radar on it. It slowed and began to curve over to the planet.

Some hasty measurements and calculations told the robot that it was still moving too fast, in danger of bouncing off the atmosphere. It braked again, then permitted the shell to drop. When it struck air, the irregular outer layer of metal-impregnated foam plastic quickly

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boiled off, leaving the foron shell, nearly transparent to radar. The outer layers of the smooth egg shape remaining boiled off more slowly, carrying away compression heat and slowing the shell still more.

The terrain below satisfied the robot: there were no concentrations of population near. Hyperica had no cities and such concentrations were quite small and well-scattered: the population was well below the critical level of one billion. Most of the planet was sparsely inhabited forest or jungle; and this section was even wilder than usual, a range of rocky, ragged hills bristling with trees.

At the last instant it calculated its rate of fall and applied power to soften the impact. The shell struck, bounced, and in midair split open. It had parted in the upper hemisphere: the lower, containing the couch, remained undamaged. The impact so stressed the porous inner lining as to cause it to spray the area with assorted volatile compounds—only a few grams of them. Most, naturally, were sprayed over the lower hemisphere.

Mission completed, the robot turned everything off.

Sky Hunter's row of shears had suffered occasional gaps over the years, and the vets had never learned how to regenerate Faeran life's losses; not even teeth or duocorn horns. However, they could replace them with artificial ones better than the originals. These had been removed and replaced with others indistinguishable from the originals; they were coated with a thin layer of reconstituted ivory dust—tooth enamel from arborodon sabers. The tooth structure itself was a crystal softer than the diamond-plated foron they replaced, but even a scanner would not detect the substitution unless suspicion had already been roused.

That crystal was piezoelectric. As his great jaws closed, pulses of very high voltage electricity played over the lock and into it. It had more watts than a casual observer would have believed, seeing nothing but the slight bulging of jaw muscles and hearing the faint click as the teeth gripped and released. Then the lock, even its zerohmic construction unable to stand the electronic strain, opened silently, the door frame unsealing itself from the cage frame.

The other dons rumbled murmurously. Sky Hunter took his time, assuring himself that there were no men near. The guards' voices came faintly from a distance, weirdly echoed from the piles of containers. But the dons were raised in a rain forest of two- and three-hundred-foot trees; echoes did not confuse them.

Sky Hunter attacked the lock of Slender Silence's cage, making faster going of it; he could get at it better. She had had more experi-

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ence both of men and planets than anyone there but himself, and was a shade faster as well as quieter than most dons, though smaller than most. She came out eagerly, wordlessly, and took up guard position, peering around one of the piles of containers. Hunter next tackled Heavy Paw's cage. His name referred not to great clumsy feet, but to thunderous blows.

Silence gave a soft cough in warning and Hunter clamped suddenly on the lock as he started to whirl away; the door unsealed. It was imperative that he not be seen opening the locks. Apparently the cough alerted the men; the dons had been utterly silent since unloading. A man who knew more about them would have known something was in the air.

One of them spoke from just around the corner of the pile of containers. Hunter had to warn Heavy Paw to stay put, lest they see him leaving and realize the locks did not open by accident. They apparently heard that, too, for their footsteps broke. But then they came on without hesitation, knowing the animals were caged, curious about these strange, great cats.

Judging their position as well as he could by ear, Hunter ghosted toward them, having no time now to look for Silence. The men stepped casually around the corner, each carrying a long-barreled weapon he recognized even in the dim light as a rifle. He knew the difference between energy weapons and projectile weapons. The instant he saw them he pounced being well within range.

They had no time to scream but they were not close enough together for him to take them both at once. He flew past the outside one, his head a little aside, sabers down; they snapped shut on the man's neck as he whirled spasmodically, shearing the head off. But by the time Hunter had landed and whirled to leap back, the other had recovered enough to turn and start to run, loose-kneed, around the corner. His mangled, disemboweled body came flying back.

Slender Silence sprang quietly back to her position on the pile, knowing that men on the industrialized Inner Planets rarely looked up. Hunter sped back to the cages, voicing a coughing rumble. Heavy Paw, dancing eagerly, joined him.

"Climb up on the pile," rumbled Hunter throatily.

Heavy Paw grunted agreement; dons prefer heights. Hunter went hastily to work on the lock of Bright Shadow's cage. This one resisted and he kept changing the angle of his bite on it, feeling the tension climb.

A murmur alerted him in time; the guards were silent. On listening carefully, he could just hear the sound of their feet. He leaped for the unoccupied pile of containers, made it before any of them came

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in sight, and ducked behind the pyramidal top.

They stopped on seeing the cages: five men in a loose group, rifles in hand. No doubt they had tried to talk to the first two guards and received no answer. They were on the alert now, though they had not found the two men.

It was Heavy Paw who struck first. The men were not in reach of any of the three free dons, but they were examining the two occupied cages, their backs to Sky Hunter's empty one. As he had expected, they had looked the piles of containers over carefully. But they were still not alert enough. Heavy Paw made one great leap, landing on the top of Hunter's cage with a booming thump, and by the time they whirled on him, he was among them.

Silence sailed over the top of her pile in one of the enormous floating leaps characteristic of arborodons, making her move while they were too busy to look up. Hunter could have got there just after her, but he leaped for the ground and raced around his pile. He ran head-on into a desperately fleeing guard, scarcely having time to dispatch him: he was moving at his incredible top speed. He dug in his thumb-claws and braked desperately, bowling the man off his feet with his chest, snapping his shearing sabers shut on the other's shoulder and back.

Heavy Paw was making sure of the wounded: Hunter glimpsed Silence just as she vanished in pursuit of the last guard; she'd have him in three or four bounds. He wasted neither time nor words, attacking the lock of the nearest cage frantically. He knew—they all knew—that men on guard duty wore utility bracelets with communication devices. To send an alarm was the work of a fraction of a second, and men could move with blinding speed, as they all knew. There'd be more guards on the way within seconds.

Loring's Mate and Bright Shadow were dancing and foaming with eagerness, their control destroyed by the fight, literally within reach of them. He managed to release them both before further action developed.

"A flier comes!" called Silence.

They all knew better than to run directly away from it. Hunter led them off at right angles to its line of approach, running full out for the seconds during which it would be out of sight behind a nearby tall warehouse. They took cover the instant it reappeared behind them. The men's attention was on the scene of carnage around the cages—a ghastly sight to men better accustomed to scenes of violence than these—and the instant the aircar partly disappeared behind the top of one of the piles of containers, he gave a rumbling cough: "Run!" and led

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them across the now-empty circle where the little transport had landed.

It seemed a long way, even at their speed; he kept expecting to see the flash and hear the ring of explosive bullets around him, but in a very few seconds they had crossed it and ducked behind another pile of containers. Silence, bringing up the rear, checked behind while they caught their breath. They were not designed for long runs at full speed.

They now had time to wash the blood off their feet, all of them fully aware that their tracks pointed straight to their present position. Most of it was already gone. By the time they were ready to move again, the aircar had climbed higher and was hovering over the opening above the cages. That meant others were coming.

They searched the lumpy horizon carefully, all feeling faintly uneasy at being caught in the open. But the port, though small, was busy, crowded with numerous docks, warehouses, and the like. They ghosted along a blank wall, raced across an open space to avoid a brightly-lighted door around which men were directing machines, climbed over the top of a low dome—feeling terribly exposed—to avoid another busy area, and finished alongside a brightly-lit strip up and down which went a continuous stream of cargo and cargo-handling robots.

To cross it unseen seemed impossible, but arborodons had studied men on Faerie for three-quarters of a century before revealing their existence to them, and had not stopped studying them since. These machines were too low and too slow to be carrying men, and there were too many of them in the stream.

Sky Hunter said, "Come. We will follow the flying machines."

Silence said, "They will see us."

"These machines will not see us unless they are told to. Maybe not then: they are made only to carry things."

"That's right," rumbled Heavy Paw. "Machines cannot think; they can only obey. There will be no time to tell them how to catch an arborodon."

Hunter led them out under the traffic, running uneasily over the brilliantly glowing pavement, setting a pace as fast as the robots' so that their motion would blend into the stream.

Fortunately the strip was merely a convenience, a method of bunching robots together to keep them out of the way; it did not pass every door in the port. Many of the buildings they passed did not even face it; their doors mostly faced in toward the docks around which they sat.

Twice they stopped and peered around them with light-blinded eyes for signs of pursuit, but if any were visible, they could not

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separate them from the normal traffic of the port. They left the glowing strip shortly and threaded their way at a rapid walk through a dimly-lit maze of domes and buildings to the edge of the port. There was a wall here to keep out animals from the forest.

The Realm of Man was almost as efficient as it claimed to be. Ronnel Alpha Sharn, Subatar of the Sixth Cycle, Archon of Space Administration, was awakened about dawn. By that time bright young men in his Administration's Traffic Department had put together the appearance of gravito-inertial radiation and the disappearance of a certain metallic meteorite on what was almost a collision course. At first they hadn't been sure that it wasn't a real meteorite and that there'd been an error in plotting its course, but they checked and found that the girad they detected could not have been an instrument malfunction, or from any known ship in space. And, of course, girad almost never occurs in nature; when it does, it's the product of rapid change of acceleration.

Consequently, a ship was down on Hyperica. The Realm of Man was penetrated.

Ronnel waited while the upper atmosphere was checked for traces of ionization that would be left by high-speed approach; when located, he notified his colleagues.

Triangulation on the ionized track gave them the rough course the ship must have followed, terminating in a hundred square miles of rugged hills that must be searched. The preliminary was done from orbit while Teodor Alpha Gold, Subatar of the Fourth Cycle, Archonof Police, got together a force to conduct the ground search. He was prepared to throw a thousand men into the area.

Verbert Alpha Callan, Archon of Strategy and Tactics, suggested that he hold men in reserve; this well might be a feint. "There may be a rain of such meteors beginning any time," he said.

"Impossible," cut in Ronnel. "My Administration has been alerted; no meteorite of any size can approach a Realm planet until it's investigated by ship."

"That makes it worse. One spy cannot do us significant harm. One saboteur cannot damage our industry or military. One agent provocateur cannot cause us trouble. They must know their trick cannot be duplicated. I say stay alert; this must be a feint designed to distract our attention from elsewhere."

That made sense. Teodor said, "I have already ordered that sufficient divisions be held ready in case of trouble elsewhere in the outlands; I'll alert my Department to the fact that any trouble anywhere may have the Empire as its source—particularly on the other planets of the Realm."

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Counterespionage, a new Administration in the Archate, one with less importance than Space—the Realm had as yet no military plans to conceal—mentioned several of the more obvious precautions it would take.

Ronnel said, nodding, "I will order all Imperial vessels restrained until this spy, or whatever, is captured."

"Have we any in port on Hyperica?" asked Teodor.

"Only the ship attached to the Imperial Correlation Service," Ronnel said.

"I distinctly remember the Archate in Policy Planning Council ruling that no Imperial, official or private, be permitted to base ships on any Realm world—for excellent reasons," said Teodor icily.

"Captain Wilnson does not own this ship, my esteemed equal. It belongs to the Archate and is merely attached to him—and the captain reports *everything* to me. Wilnson rarely uses it. I thought it would do no harm to send an occasional observer into the Empire. Not that I expect to learn anything of primary importance."

His fellows looked hard at him, all but Verbert of Strategy and Tactics, who nodded understandingly. "Better to give at unimportant points than to goad them to action. That was also decided in Council."

"And besides," Ronnel added, "the dispensation is mine; *I* am Archon of Space Administration."

When it was put like that, they had no choice but to agree. Ronnel made a mental note to watch Teodor. The other had long been jealous of Space Administration's near-monopoly on contact with the Empire; Ronnel had earned several promotions on the strength of having found the sinister designs behind a number of trade agreements proposed by the Empire. Teodor had been reduced to claiming that the irruptions of the disinherited animals were backed by the Empire, a pitiful assertion that brought him nothing but laughter.

When the others had signed off, Verbert looked at him closely. "I realized you had something in mind when you began to cultivate the Correlation agent so closely. You've shown commendable imagination in the past, so I won't warn you of the dangers."

Ronnel nodded. "I know; Imperial Correlation Service is probably the most important part of the Empire's mission here, despite its lowly position. I confess I never saw the possibilities of this information-exchange idea until recently. By giving him a play, I am setting him up for any of several operations."

"Learned anything from him?"

"Nothing significant; he's a competent agent. Right now he's playing the role of Correlation Captain to perfection—except for logic, I

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wouldn't know he was an Intelligence agent at all."

"What sort of operation do you have in mind? Or is that asking too much?"

Ronnel hesitated, thinking rapidly. It would be difficult for anyone to steal any of his credit; Wilnson wouldn't deal with them. They could only break up the situation. Ronnel's position did not threaten Verbert's, though; he probably wouldn't bother. And the old Subatar would make a valuable ally.

He said, "I had in mind dropping misinformation in front of him as if accidentally. Piping false data into the Empire's circuits. Recently, however, I've had larger ideas. The man is rather obviously cultivating me. That's consistent with his pose, trying to bring about full information-exchange between the Realm and the Empire. He's made me a number of gifts and concessions, equal to the ship I placed at his disposal. I collect information about odd animals, you know, and occasionally a few specimens. It's occurred to me that he may attempt to bribe me. That would be better yet."

Verbert nodded. "A good, workable plan, though somewhat long-range. It may not be as simple as it seems now, however. Such false data will have to be prepared very carefully; we have as yet no way of knowing how much Correlation Service, or whatever they call their Intelligence section, already knows of the Realm of Man."

"That will be a subject for the Archate to decide, in Policy Planning Council. I do not anticipate any difficulties."

"*I* do; that is my domain. Captain Wilnson, as you've indicated, is himself no fool, and he must have wiser superiors."

"Hardly wise enough to deceive the Archate."

"Perhaps not, but certainly wise enough to deceive, say, a Subatar of the Sixth."

Verbert was a Subatar of the Second Cycle and would probably soon be raised to First. Not that it would do him much good; his breeding days were over.

Ronnel said, "I will exercise the utmost caution." As members of the Archate, they were theoretically equals, but the rest of the commonalty of the Subatars would be all too likely to remember that he was born a Subatar of the Eighth Cycle. He sometimes suspected that, despite what they professed, the upper Cycles were not pleased to find evidence of higher evolution in the lower Cycles.

He was not feeling at all pleasant as he turned to the day's duties.

His secretary, a graying blade of a man with a faint frown between his eyebrows, nodded abstractedly from the breakfast table. The other rated alpha but was not a Subatar; he bowed when Ronnel

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returned the nod. Ronnel was no stickler for protocol; he knew that meant bad news.

The frown deepened. "Your most recent specimens have escaped, Your Superiority."

Not even arborodons could leap the wall. They also knew that there would be few if any gates in it; when men wanted on the other side of a wall, they flew over. On the other hand, it was meant only as a barrier to unintelligent animals from outside. Inside, many buildings butted against it. They trotted rapidly along, some hundred yards inside it, examining buildings for one that suited their purposes.

They found it just before they were spotted.

That was not their fault; the smallish dome past which they trotted meant nothing to them; only after the powered door snapped instantly and silently open did they realize it must be a house for the guards. There were the scents and sounds of many men inside. The light did not quite reach them, but they were too large to go unnoticed. Even as they leaped out of the area of brightness in front of the door, a man yelled.

The dons streaked forward, intent on the wall. Once around the guardhouse, they confronted a warehouse, behind which was the row of buildings along the wall. They raced across the open, ignoring robots working around a door of the warehouse, and followed Hunter up onto the roof.

Seconds later a dozen men poured around the guardhouse, excitedly waving solenoidal rifles, jabbering and pointing in every direction. A row of hot-eyed, eager forest devils looked down on them as an authoritative voice spoke. They heard him explain to the reckless guards that these animals were dangerous, to stay together. The men were formed into two groups, warned to go with caution and to keep in touch, and the groups started around the warehouse in opposite directions toward the wall.

Sky Hunter indicated the group going in the opposite direction from the brightly lighted door around which robots were working, the shortest way around the warehouse, and the dons ghosted across the roof after them. When they had turned the first corner, Hunter looked down in satisfaction, arranging the final details of his simple plan.

He dropped silently off the roof around the corner from the guards, in plain view of anyone who might come around the guardhouse. When the rest had joined him, he peered around the corner, saw that the men were scarcely a hundred feet away, moving rather slowly, not too close to the wall; the shadow made it darker there. It

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did not seem to occur to them to look back.

Hunter paced deliberately around the corner, swinging away from the wall, and as the others followed, he stepped up the pace until they were running silently, nowhere near their top speed, in a line after the half-dozen guards.

One of them sensed the approach, or glanced back out of sheer nervousness. He had time only to gasp; the dons slashed through them like a transonic airship through the upper atmosphere. Silence, bringing up the rear, paused to dispatch one that remained conscious; the rest they did not bother about. Hunter laid his belly close to the ground and flew, intent on making it to the roof of the next building before the other group rounded the corner of the warehouse.

They made it to the top of the building they wanted with only seconds to spare. They were not safe here from aircars, Hunter explained while they caught their breath and licked their paws. He and Loring's Mate checked the land beyond the wall and were relieved to see that it was covered with low shrubs. All trees had been killed to prevent animals from using them as bridges, but those shrubs would afford excellent cover for the camouflage-coated dons.

They leaped easily over the wall from here, moved some distance along it, and rested. Presently an aircar without a top appeared above the building; a guard flier. Their most recent trails of bloody footprints had been followed that far. That was quick work, since the traces would be faint after their fifty-yard dash to the second building.

The guard flier came over the wall, the long thin barrels of spray guns clearly visible, and checked the foot of it. They could not miss the deep marks where the heavy dons had landed, and Sky Hunter braced himself to leap into the flier when it came into range, but the guards were not experienced field men. Tracking animals was no part of their business and they were only too well aware that they lacked the necessary equipment. They poked about half-heartedly, got back into the flier, and went back over the wall.

"Time to move!" said several of the dons at once. Hunter whetted his fangs as he led them at a quick trot through the head-high brush. They fanned out in a long line, moving quickly from one bush to another, peering around and back frequently, leaving scarcely a trace of their passage. Despite their weight, their great paws bore them lightly over the firm ground. It would take better light than this to see their prints.

It was a quarter of a mile to the forest, and they had nearly

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made it before more fliers came. There were a couple of conventional aircars, too. Seated or lying behind or under bushes, the dons watched calmly and with no small amusement the scurryings and comings and goings of the men. Presently all the aircars and guard fliers went back over the wall.

"The hunt will not begin until dawn," said Sky Hunter, satisfied.

"That will give us time to make a good start," agreed Silence.

Reporting to one's superior was a concept utterly unknown to the dons, but they knew that the first man to discover a situation almost never decided what to do about it; that was left to others. They could understand, however, the idea of tracking instruments more sensitive than their own noses; they had all worked with either the frontier Colonization Service or Penetration Service and had had plenty of experience of them.

They turned back to the forest, determined to push on all night.

Verbert Alpha Callan, Archon of Strategy and Tactics, called Ronnel about noon to inform him unofficially that the ship had been found. It was now in the domains of Police, Counterespionage, and Field Resources—Forestry Division—with Strategy & Tactics coordinating. Ronnel would receive a final report, along with the other Archons, but would not be kept informed officially. He appreciated the courtesy; it began to look as though he'd acquired an ally.

"Any trace of the spy?"

"Traces, yes; his odor was all over the area, they tell me. Rupert sent out a squad of his best foresters and they have him typed. But they haven't been able to pick up his trail yet. Probably washed himself off on the edge of the clearing and applied an anti-odorant. It must be a good one."

"The Empire is in touch with the frontier Penetration Service," observed Ronnel. "Such compounds would have great value in opening new planets; they've probably raised it to a high degree of efficiency."

"No doubt. It begins to look as if this will be a long search. We've called in Henery to check the organic compounds in the ship for distinguishing kinds, to see if we can find out what planet he's from. That may help give us a lead."

Ronnel nodded. Every planet has organic compounds found nowhere else; animals and especially plants could always be identified by planet of origin by such distinguishing compounds, but once moved to another planet, most of them rapidly lost their distinguishing types. Most such compounds were found only in minute quantities, and in most cases it was not known just what part of the ecology synthesized them or why.

"Will he have time to reach the nearest unit?" asked Ronnel.

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"He's on foot. We think so, if he keeps moving. Someone mentioned the possibility that he was injured because the ship split open on impact, but that was intentional—a safety measure. Besides, he was all over the area after impact, judging by the instruments. Henery has had an idea: he's checking for exotic diseases. He'll find nothing, of course. There was a large record crystal hooked to the robot. Clifton seized it to analyze for secret instructions and the like; his men will shortly be posting the lower ratings on the latest Imperial fiction. Teodor is frothing at Rupert; his Police have largely been kept out of the area. It's a job for trained foresters, and though the Police have had a lot of field experience, it's true they aren't up on tracking by eye. Instruments are useless. You can imagine what it would look like with a thousand Policemen trampling in circles around the impact area." He smiled faintly. "As the news commentators would say if they were permitted to mention the subject, the Archate is responding fully."

Ronnel grinned faintly back. "Well, Space Administration is alert; I've done some checking to make sure. Are there any signs of trouble anywhere else?"

"No; I've made it a point to make sure. Even the animals are quiet. Only a couple of guard posts lost in the last day, neither here on Hyperica, according to Teodor. He's too careless with his men, I think. A pack of them wiped out, I believe; he's not releasing details yet. I haven't modified my original idea about the spy being a feint, but I confess that I can't think what he could be covering. I don't expect to learn anything either from the ship or the man; he at least will be completely ignorant of his real purpose here."

"So it's just a matter of sitting tight and watching. Well, at least we are alerted. Maybe something went wrong with their plans; the timing, say."

"The thought had occurred to me. I'll keep you informed."

It was midmorning before Sky Hunter called a halt for rest. They had traveled since a little after midnight, and though their course had not been straight, they were now a considerable distance from the spaceport. This area was not inhabited; the port had been built on unused ground. It was not as rugged as he would have liked, though.

"When will the men find us?" asked Heavy Paw.

"They will not begin the search until after dawn," said Hunter. "Perhaps about the time the dew goes. They should come upon us before noon."

"We have then some little time to prepare," said Bright Shadow, looking around with switching tails.

"I wish this was more broken land," rumbled Hunter.

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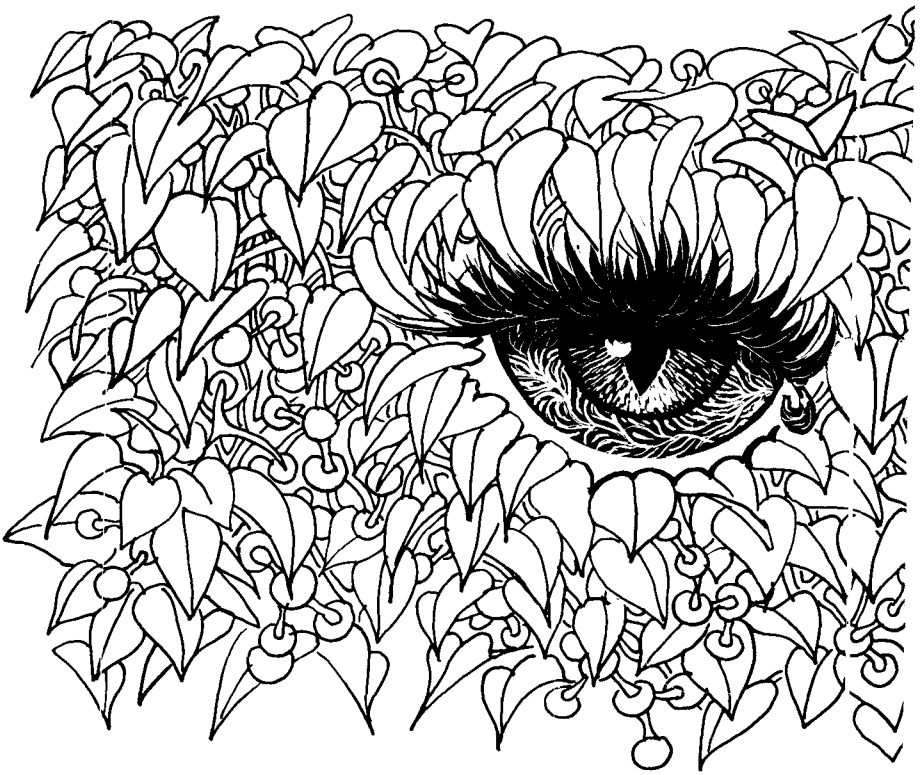

"We must take them from the trees," Loring's Mate told them. "Lay a trail on the ground, then surround it from the air. If they come in open fliers, they are our meat."

"We will have little time to eat," Hunter warned, examining the area.

"How hard will they pursue us?" asked Slender Silence.

"That cannot be said," Hunter told her. "I think it likely that this first attack will send them back. We will not seem important enough to them to waste lives on us."

A little farther on they found a rocky hillside, almost vertical, fully exposed to sunlight, that looked appealingly comfortable in their tired conditions. Best of all, there was only one convenient place to land an aircar, that at the top of the sloping rock.

They left a plain trail to it, wading through the soft earth at the foot of it, and left giant paw-marks

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in dirt—almost mud—up on the rock. There they also systematically trampled down the few small shrubs and weeds that grew on the slope, to make it seem they had rested there some little time. The men would be tense and alert, knowing they must be near the dons by now. But then each of them went back down the slope separately, fanning out in five directions away from the hill, as if they'd settled down and were now out hunting. After so long a run, hunting in daylight was logical; dons were not purists anyway. They circled widely, came back to the rock slope from above, and took their positions in the short trees of this planet.

They had an hour of rest before they heard voices. Presently Hunter caught a glimpse of movement beyond the thick copse rooted in the wet ground at the foot of the hill; an open flier landed just beyond it and a man descended and

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bent over the ground. One of the others stood up to peer through the trees at the slope, called and pointed. The tracker got back in and the flier lifted over the top of the tangled copse, hesitated over the steep slope while the men peered over the sides, then settled to ground between the motionless dons.

Two of the men got out, looking nervously around them, looking directly at two or three of the camouflaged arborodons, then turned their attention downslope. Two more men brought tracking equipment with them and approached the slope carefully, leaving the last two in the flier, with rifles to hand.

"They've been here, all right," said one, looking at the tracks.

"Not been very long, either," added another.

"Did they see us and run?" asked yet another.

"Possible."

"Well, they didn't come up slope," said one with tracking equipment. The spectro was more sensitive than any animal's nose, but the fool handling it did not seem to know the difference between airborne and ground odors. The scent of arborodons was all over the area anyway.

"Howlen, you go down to near the foot of the slope on this side and cross it. I can see from here where they came up. Find the place where they went back down."

"It is done, Your Ability."

Hunter watched them, thinking, *These are not good field men; they talk too much.*

One of them climbed down the slope, another with tracking equipment stood near the center of the "bedding grounds," and two guards with rifles stood above the short, steep slope just above the grounds, in no position to render immediate aid, though their rifles partly compensated. They were probably loaded with anesthetic bullets. The dons knew about anesthetics, but they also knew that these men would be using the wrong kind to stop arborodons.

The two guards still in the flier would be using explosive bullets.

One of the first pair of guards had moved over to one side of the little clearing, partly out of normal precaution, partly for shade; he reached out one hand and leaned against a tree trunk, almost putting his hand on Loring's Mate's leg. Looking around from behind nearly-closed eyes, Hunter saw that they were ready.

Bright Shadow opened her eyes and looked at him in signal, an astonishing sight even to a don—a pair of great green eyes floating unsupported in a thick bush. He could not open his own—he was looking up toward the flier—but he flicked a leaflike ear and Shadow pounced. She was the only one in certain reach of the flier.

Silence boiled out and streaked upslope to her aid. One of the star-

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tled guards got off a one-second burst at her: sharp cracks and hard bright flashes ripped through the treetops beyond. Heavy Paw erupted in an earth-shaking roar that drowned the burst, landed with a thud beside the first of the guards on the slope, and swept his crushed head off with one blow.

To do so he had to rear up and that cost him his lead. Hunter bounded downslope, booming his own paralyzing roar, and knocked the first of the trackers, who seemed to be in command here, off his feet, snapping at his head. He had one glimpse of Loring's Mate jerking the other guard backward as he raised his rifle. There was no time for Hunter to make sure of his first man: Heavy Paw landed with a grunt behind him. Both leaped instantly, with blood-freezing, tree-bending roars at the gray-faced, paralyzed survivor. Hunter was a little quicker, but Heavy Paw hurried him: he snapped and slashed at the man as his rush carried him past.

Heavy Paw landed a little in front of the guard, tearing up earth and scratching rock in his eagerness to slow enough to get in a blow at him, while Hunter twisted in midair, bracing himself to drive his disemboweling slash home. A fraction of a second later the man all but disintegrated as a ton of arborodons competed for his attention.

Heavy Paw laughed a little, good-naturedly, but Sky Hunter whirled and leaped back upslope, remembering the first man he had downed. He found Loring's Mate sitting bright eyed and laughing beside the body, washing blood off her paws and watching their race.

Hunter rumbled a breathless, amused congratulation and bounded back up the slope to the flier. Here all was serene, if you didn't mind pools and splashes of blood. Hunter did not favor them, but they did not disturb him: they were not as bad as mud or sticky sap. He climbed into the flier and examined it keenly.

Silence and Shadow carried the bodies out with them and began desultorily trying to get some of the meat out of the clothing, a difficult and tedious job. Hunter raked at the cushions without much better effect, but did make a little impression. He was unable to scratch most of the instrument panel, but the buttons on it responded to his claws. Several panels opened and he took care to rip out everything that would come.

He recognized the antenna compartment for the coms and was careful to destroy the net of soft, not very tough cords of zerohmite; not unlike the cheapest kind of plastic. With them gone, he knew, it would be impossible for anyone to call this flier or, more important, trace its location.

Calling the rest away from their virtually fruitless attempts to eat

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their victims, Hunter led them into the short forest. They were all tiring now and hungry, very hungry; it takes a lot of meat to fuel such bodies. However, this was a short forest by their standards; these low-growing trees permitted much light to reach the forest floor, where it produced plants to feed a wide variety of animals. Within an hour, now that they had leisure to hunt, they had all killed; mostly small, almost bite-sized animals.

It was better not to take the keen edge off; they ate lightly and kept on moving, at their normal stroll now. Arborodons are nomads, but they were not accustomed to such rapid and prolonged travel as this. Hunter wanted to keep moving throughout the night, but knew it was impossible. He had a thorough respect for men's tracking equipment—and their weapons.

Ronnel examined the report with satisfaction. It was a pleasure to contemplate the smooth functioning of his own Administration, comparing it to the head-chopped-off flutterings of some of the others in this crisis. His meticulous actions would contrast very favorably with the failures that were apparently being produced in other departments concerned with the emergency.

Summarized, the report concluded that the spy's capsule had been dropped at least a billion miles out from a small starship that crept close at very low speed. Detection of a ship on overdrive can only be done from either another ship in warp, or with a not very effective overdrive detector based on a new innovation in overdrive radio. This ship was just too small and going too slow to be detected. The capsule already had a high velocity toward the sun. It braked down gradually and warped almost into Hyperica's orbit while on the other side of the sun. After that it was a matter of sitting tight until the capsule caught up with the planet.

Overdrive patrols were being extended to a trillion miles out from every primary in the Realm, except systems having no inhabited planets. It would take two months to reassign ships enough to make such patrols continuous; in the meantime, Hyperica alone was completely protected. Ronnel knew better than to request more ships, or even mention that he was short of them as a hint.

He had it telefaxed to all Archons as routine, under the spy case's "Categorical Secret" classification, and made a note of the men in his Administration that drew it up.

Finished, he called the director of spaceport guards for a report on the status of the search for the arborodons.

The man frowned uneasily; he rarely even saw Ronnel's image, as his was not a particularly important post. "I am awaiting a report my-

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self, Your Superiority," he said. "We lost contact with the party searching about an hour ago, and we weren't able to locate the flier."

Lost contact . . . Ronnel had a premonitory twinge. He'd already lost an embarrassing number of men. "Didn't they have their beacon on?"

"Yes, Your Superiority."

"Then what do you mean, you can't locate them?"

"Apparently the com equipment was destroyed."

That was a thing that he hadn't thought of—the disinherited animals. It wasn't just a matter of bringing in the dons, he realized too late. "Wait a minute. You have the record of the location, don't you? Or weren't you recording?"

"Sir, perhaps Your Superiority is not familiar with the system in use here at the spaceport. There are so many machines in so small an area, robots, fliers, aircars, and so on, that the robots can't keep track of them on a continuous basis. Instead, the coms are left on automatic trip, and every so often—about thirty minutes with guard fliers because they aren't so important—the robots more or less count the roll to find out where they are. Whenever they go outside the port, the location is recorded on each count, but the position check is still not continuous. I understand they do it different in Field Resources and Police. I never thought or I'd have seen if ours couldn't have been adjusted to continuous position check. But who'd have expected the animals would come this close to the port?"

The man was right. "This expedition you've sent out—I presume it will proceed to the last recorded position and try to pick up the dons' trail. Have you arranged for it to be recorded continuously?"

"I never thought until it was gone, Your Superiority, and then I didn't like to call it back. I'm making arrangements now, but the techs haven't completed their work."

"That should be satisfactory. Call me when they find the first expedition."

Ronnel switched off and brooded. It had been foreseen when the principals of Atamanic eugenics was formulated that many of the animals would resist. Whether they lived or died was not considered important so long as their blood did not contaminate the lines leading to the Avatar. The Realm was open to damage, more or less, from the wild ones, as its population was scattered, but they were not considered a real threat. Sometimes they swarmed yapping over a small refinery, or farm, or other post in the wilderness, but for the most part, the population of the Realm lived in units of tens of thousands of people. The installations did not matter.

They had a certain elementary

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cunning; it was just like them to move so close to the spaceport, almost into the heaviest patrols Teodor made. And no human being could come within miles of the port without triggering all kinds of hidden sensors. But it was bad for him. Already his casualties were shocking. His guards were not experienced in forest work, nor in dealing with disinherited animals; and the arborodons themselves were dangerous. They were hampered, too, by the fact that they had to use anesthetic bullets that might not take effect quickly enough. They would not dare use their explosives, he knew, until too late, knowing what his reaction would be to the loss of any of the specimens. Yet he could not bring himself to tell them to abandon the chase.

He could report his embarrassing difficulties and ask to borrow trained men from Field Resources or Police, he knew; but he had no intention of admitting his discomfiture. He couldn't trust Teodor anyway, and did not like Rupert at all; the other had been born in the Fourth Cycle and made frequent sneering remarks about how progress toward the Avatar had to be consolidated with each generation.

There was a better way to get the use of some of his trained field men, though he would be unable to explain it to any of the Subatars above the Sixth or Fifth Cycles. It was doubtful if any of his equals in the Archate knew it, but in the lower ratings, below the Subatars entirely, the Realm of Man was far from achieving total organization along the lines of the principle of Atamanic eugenics. It was more than conceivable that some of his men at the lower levels had rendered aid to their equivalents in Field Resources, out of friendship. Now would be a good time for those friends to return the favor.

He made a mental note to hint about it to the director of guards—the man would be surprised—and called Captain Wilnson. It would be interesting to place the man in charge of the recovery expedition

Five footsore arborodons paddec their weary way through deepening dusk, into steeper and more ruggec hills, under comforting tall trees. Weary as they were, it felt good to have leaves overhead, blocking out the sky. Sky Hunter had studied a map of the land around the spaceport on Hyperica, but he not only could not remember it well, he had no idea of the direction they had traveled the first night. At dawn they had trimmed their course by the sun. All he or any don had been able to learn from maps was area and place names; they had no pictorial sense. But he knew that there was no range of rugged hills within ten days' march of the spaceport, so this couldn't be very large. However, it would do for the night, and maybe longer.

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Sky Hunter asked, "Do you think we should stay here until they stop hunting for us?"

Heavy Paw asked, "How long will that be?"

"We cannot say."

"That might be wise," said Loring's Mate. "Here we have the hills and taller trees. They will catch us again before we find a better place to lair."

"We should not stay here long," warned Bright Shadow. "It is too close to the spaceport to den."

That was true. Each of the three females had mated before this trip was begun, with other males. It would be months yet before they began to slow down, but when the cubs were born, he and Heavy Paw would be busy for a time feeding the mothers and young. There'd be no time to deal with pursuers. They did not dare den so close to the port.

Hunter ran the probable actions of their pursuers through his mind, drawing on his extensive field experience with men, and concluded tentatively that there'd not be more than two more parties out after them. The hunt should be over within three days. Silence agreed, though pointing out the uncertainties; no don ever achieved anything like understanding one man, let alone a group.

"Three days of rest will be more than enough," said Shadow.

"We will leave our scent all through this copse," said Heavy Paw. "When we leave, our trail may not be noticed."

They padded limply deeper into the hills and finally holed up in a heavy thicket. It was near dawn when they were awakened suddenly by the odor of wood smoke.

"You understand, Your Superiority, that I'm just a cybernetics engineer, specializing in data storage and retrieval," said Captain Wilnson, frowning. "I've gone hunting a few times, but I'm definitely not an experienced field man. And I know no more about arborodons than you do. Less, probably; you have no doubt studied the records far more thoroughly than I, and in any case it's your hobby. I'm completely out of my class."

"That's all understood," said Ronnel impatiently. "In fact, it's your services as a tech I need. My spaceport guard equipment is not programmed for field service. If you'll help prepare it this afternoon, it would not be necessary to take actual command in the field tomorrow morning; I can provide trained field men. But there should be someone at Base qualified both to coordinate effort and to advise the men on the dons' probable actions."

"A good field man's estimate of possibilities should be better than any of my advice. But that does not sound too difficult. I'll agree, if you'll take responsibility for any casualties; I've warned you I'm no expert."

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"I can hardly help taking the responsibility," said Ronnel, signing off. It was the strongest emotion Captain Wilnson had ever seen him show. He must have lost a lot of men. Remembering the size of the great cats, Wilnson shuddered and hoped they wouldn't talk him into going into the field after them.

The arborodons were rested, though not refreshed; they had not been eating well lately. Food, they agreed, was the first consideration. The hills seemed almost as rich as the more open forest in game, and presently they had each caught breakfast. After a small meal they were temporarily satisfied. The workout had been good for stiff muscles, too. It was a dangerous group of arborodons who padded silently off to investigate the smoke.

They found a carefully buried ash heap and the odors of numerous men, a trail leading off in the general direction of their lair of the night—on the ground. That was unusual, they agreed. Hunter detected the odors of fourteen people, which was as far as he could count. Bright Shadow could count to sixteen, and they agreed there were more than that, but their counting was not an abstract process; they held each separate entity in their minds, which limited the process. Hunter searched carefully for footprints, but did not find any. The men had moved with the utmost skill.

The dons followed them at a steady trot until they were within a few minutes of their lair. It was obvious that the men would pass it well to one side, avoiding the denser thickets. But when they must have been abreast of the lair—the dons had closed rapidly on them—the dons heard a shout and the crackle of beamer fire. Explosive bullets sprayed leaves. Running footsteps approached.

They took cover quickly, and presently a group of men and women came through, the ones they'd been following. They were dressed raggedly, in brown and green, and smelled of smoke and the forest. The men lagged, looking back; the women and children hurried on and were soon out of sight. From near the lair came a sudden outburst of shouts and shots, and presently more of the men came running through, carrying weapons like nothing the dons had ever seen.

But an aircar was already nosing through the branches; fully enclosed, and with a larger crew than the flier of the day before. The dons climbed higher in their respective trees. Presently it came over, a little higher than they were; it was going quite slow, flying support and cover for men on the ground. These men had tracking equipment and looked and smelled like guards.

When they came to the point where the dons had left the ground, they called excitedly and the aircar stopped. A door opened and one of them leaned out. Excit-

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ed words flew around the heads of the unnoticed dons. Sky Hunter looked around at them; they were ready. And for once he himself was in the best position.

He leaped full at the aircar.

The man in the door gasped once, then Hunters' great deep chest flung him back inside. The car rocked to the impact. It was close quarters inside, and Hunter barely had time and room to strike a short, smashing blow at the pilot as he roared thunderously. In the confined quarters it seemed to split the head. Clawing over the pilot and the other man, he ripped open a man at a spray gun in the other door, then whirled with frantic speed to reach the others. He scrambled over the seats in the front and launched his great bulk at the men in the open space in the back. One of them had been engaged in removing long, straight sticks from the limbs or bodies of the other two. Hunter did not stop to ask himself questions; they were all dead within moments.

Returning to the front, Hunter asked how it went below. All was quiet down there.

Heavy Paw's rumbling, coughing voice was taut with feral anxiety. "Silence has been hit!"

He could see her looking up, legs trembling; but there was no sign of the terrible wound an explosive bullet would leave. She looked dizzy and obviously had difficulty standing. Anesthetic bullet. These people did not know the right kind of anesthetic; she would remain conscious and should be all right within an hour. He reminded Heavy Paw of that fact without mollifying him much.

If there had been time, and if he had not been worried so much about her himself, the other's attitude would have amused him; female arborodons were not protected and cared for by their mates except when bearing. Not long after that the relationship ended. Heavy Paw was several months previous.

But though highly independent, arborodons were also highly cooperative. She would have to be cared for until she recovered. Though they did not know what a planet was, exactly, the dons were perfectly familiar with the idea of being alone on one; they knew that no matter how far they traveled in what direction, they'd find no other arborodons.

Silence was still grimly standing. She did not appear sleepy, but she was dazed, her reaction time was slow. She could not talk well, and her memory of the time under the drug might be hazy, they had been told. Her symptoms jibed with what they had been told they should be, so she should recover soon. But Hunter found himself in a savagely anxious frame of mind, his thought processes correspondingly slow and agonizing.

"She must wait here while we go

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after the other men," he told them finally. They led her some little distance and concealed her where she could not be seen easily, then started through the forest with ferocious speed.

Captain Wilnson had not been particularly surprised to discover the lowest ratings in the Realm of Man, the deltas, were as a class almost smugly happy. They made up the largest group, a little over half the population, and had only the most menial jobs—machine supervisors, technicians, and the like. Each rating, from alpha to delta, was twice as large as the one above it, and had about half the privileges; these privileges and responsibilities counted here, not money. The upper ratings paid for their privileges with danger, thereby proving their higher evolution; the higher one's rating and the greater his responsibilities, the easier and quicker his fall. The deltas and gammas had little to worry about as long as they did their jobs and said only what everyone else did.

Officially Imperial citizens were rated as the equivalents of deltas in terms of privileges, though they were restricted to certain specific localities. Nobody objected to his taking control of the search party, though that was nominally work for a gamma at least, perhaps even a beta. The guard director was a beta. But he had noticed before that the exclusivity of the higher ratings was practiced fully only by the alphas.

The gammas held down the foremen and coordinating positions one step above the workers, and some of the more highly skilled jobs. The betas were mostly professions and lower-level administrators. None of the lower three ratings had any voice in the government or the policy planning of the big syndicates which they all nominally owned, or seemed to want one.

Only alphas voted, and only the upper half of them, the Subatars, could serve in the government. It was just barely possible for an exceptional man to raise his rating once in his lifetime. He was still a little vague about what happened to deltas who lost their rating.

They showed him a visual record of the bloody shambles of the rocky ledge where the dons had ambushed the first party, and he was relieved to note that he was not the only one who turned pale on seeing it. He and the experienced field man set up a careful safety system. As they lacked enough aircars—they should have had two, but the operation had to be kept small—they had the men divide into three parties. One flew the aircar and covered with a spray gun, single barrel, to be used only as a last resort. This one carried the ikons and was his eyes. It followed the other two groups, one of which went ahead, very lightly armed, mostly with beamer pistols,

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and had the instruments. The second one followed with rifles.

In the event of attack, the first ones were to dive and hug the ground, leaving the second a clear field of fire. It in turn should dive if it was attacked, but they assumed that the dons would ignore the second party until they had disposed of the first. The anesthetic bullets were not fatal to humans, but were not good for them; and in addition, they were fired by powerful solenoidal rifles and could do no small physical damage, though they were lightweight.

The tracking south from the ledge was tedious, the experts in the field—Ronnel's experienced field man had taken over there, leaving Captain Wilnson in the port—positive that the traces were at least half a day old. The dons had been by there the previous afternoon. Things didn't begin to look interesting—aside from the nerve-wracking possibility of the field party being ripped to shreds before the base party's helpless eyes—until the sun was an hour or so high. They found the don's bedding grounds, and there traces all around that had been made that morning.

"Some of these seem to have been made an hour or so before the others," reported the field man. He was a beta but not too self-important; Wilnson could have liked him with a little encouragement, though he knew the man's way of life had to be destroyed.

"Judging by the blood and scraps of fur, I'd say they went out and caught breakfast. Then they left again, but they may be standing all around the area, waiting to pounce. Certainly they were here within the hour."

"Would they keep on traveling today, after having traveled all day yesterday and half the night before?" asked Wilnson.

"I couldn't say. Hyperica hasn't got any such animals any more; I don't know just what they'd do. It does seem odd that they'd keep moving. Maybe they're out exploring this area. They may have decided to make a permanent lair here. . . . Just a minute. I've got the spectros adjusted now, and I don't detect anything nearby. They may not be gone, of course. Andrei, the infrared—any traces?"

Andrei reported no traces of the wave lengths generated by large masses of warm flesh.

"That means we'll have to follow them. You'll go first, Andrei, after I figure out which trail to follow—"

Andrei interrupted him and for several seconds they conferred in low tones, in doubt about what might have been a reading. Wilnson had the aircar rise and turn the ikons in the indicated direction, but saw nothing. The ground parties decided to check it out; it might have been the dons returning. The aircar followed them slowly for some little distance.

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They paused in a glade; that felt safer. Andrei had some indications, stronger now, as if the animals in question were behind bushes; still faint enough to be uncertain. The field man could not corroborate it with the spectros, though he picked up something.

"Some other kind of animals, perhaps. There may be sards nearby. It's definitely not arborodons. I don't think—"

A long thin stick flicked across the glade faster than the eye could follow, not tumbling but in a straight line. It whipped completely through the beta, who whirled and fell, gurgling. The rest of the ground party stared in utter amazement until a multiple whistle and swish swept through them. Several more fell and the rest dived for the ground.

"Animals!" bellowed one of them. They began to fire wildly into the bushes. No more arrows followed, but Captain Wilnson, in stunned unbelief, glimpsed several men running. They were hard to see and they took full advantage of every scrap of cover.

The aircar started after them, the gunner turning his terrible spray gun toward them. As Wilnson sat paralyzed, the director of spaceport guards, beside him, barked, "Stay near the ground party, you subhuman idiots! Don't let those animals get behind them!"

The aircar stopped and turned to bring the gun to bear on the bushes around the glade. They seemed to be empty now. The director said to Wilnson, "Those disinherited animals can be pretty sly." To the men in the field, he said, "Pick up those wounded. Any fatalities?"

One of the men had run after the aircar when it started after the men —"animals?"—who had ambushed them. He was armed only with a beamer, but he got off the last shot of the defense. One of the ambushers stood up, exposed from the waist up but still hard to see against the tree behind him, and looked back at the results of the ambush. Captain Wilnson nudged the director and indicated him just as the guard threw down.

The pencil-thin beam struck him full on the chest, but the range was over a hundred yards; it could not be held steady at such a distance. No doubt the victim suffered first and second degree burns all over his chest; it did not seem to bother him. With a swift, deft motion he loosed another arrow, which whipped past within inches of the guard's head. It was obvious these men's strange, primitive weapons outranged a beamer.

The director said, "I've often discussed these animals with some of the men from Police and Field Resources. I've never dealt with them, though; they don't usually get so near the port; it's too well patrolled. One thing they all say is

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to stay close together, never detach air cover from the ground party. You lose most of the ground party almost every time. At first we thought the other party had been hit by them," he added.

Three of the men were dead and two others badly wounded. The arborodons were forgotten as the field party started after their assailants with their revenge indicators glowing. Wilnson said nothing, tried to act as if this was all familiar; the others had forgotten for the moment that he was an enemy. He would report all this to his superiors in Correlation, though he suspected that much of it was already surmised.

He had a mental image of this kind of government being imposed on the human-occupied Globe. He had known there was some danger and many frustrations in this assignment to the Realm of Man; it was the only interstellar government known that was calmly planning to take over the galaxy, even if it did not expect to begin for centuries. Until after it had bred up the "Avatar." That made it the most dangerous. It was small now, but before faster ships and the overdrive radio made interstellar government possible, it was the largest unity in the Globe. The century-old Empire was dedicated to the prevention of war by eliminating separate governments; its plans for the galaxy were not much different from the Realm's. The major difference was the looseness of the terms of union.

Suddenly Wilnson realized that he knew now what happened to deltas who lost their rating—or to some of them; very few must be able to make it to the wilderness.

Andrei had been killed and in the excitement the man who took the infra-red detector was not paying much attention. Bare-eye examination of the bushes was faster and almost as accurate anyway. The spectros were readjusted to the human band. They detected something and the aircar stopped, but the men had forgotten the dons temporarily in the excitement of the chase. Thus the only warning anyone received was the sudden catapulting of a clump of leaves into the aircar.

The aircar was leading and the ikons were set on its dash, inside the transpex windshield; Captain Wilnson and the director had only a brief glimpse of the don. It vanished behind their point of view and the view rocked. A thunderous roar made two or three of the techs leap away from their panels, and he and the director exchanged horrified glances. Both were white to the gums, but there was nothing they could do. They could not even see what was happening; the horrors that took place could only be pieced out by the suggestive sounds and one small spray of blood against the inside of the windshield.

A series of victorious roars, then

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silence. It was all over in mere seconds. The techs were frantically calling, but got no answer. After a moment, the director ordered them to stop. "The arborodons left no survivors before," he remarked. He thought a bit, then told them to order the aircar to turn around so they could see the men.

One of them frowned. "Can't you raise the robopilot?" the director barked.

"Yes; it's relaying this view and its position. But that's all it's programmed to do. It won't take orders by com except from the port traffic control robot; and it isn't set up to give such detailed minor orders; the code doesn't allow for it."

After a short silence, the director said, "We're not properly set up for this. Order the aircar to return; and we'll not risk sending men after the bodies. I'd better cancel the operation pending further orders. This must be reported to the Archon immediately. There really are animals out there; it turned out before it was the dons who ripped up the inside of the guard flier and ruined the com antennas."

Wilnson agreed to corroborate his report; he was rather curious to see how the imperturbably superior Subatar took this.

Though they had had experience at being the only arborodons on a planet, the feeling still did not make them happy, especially now with Slender Silence wounded and helpless. The raging anxiety had dispelled all traces of cool thought, and Sky Hunter dimly realized that it would be difficult to restrain them—including himself.

Then they were taking cover ahead of the still-fleeing women and children. Heavy Paw and Bright Shadow took up stations on a massive log, Hunter on the stump. Loring's Mate covered them from a tree. The stump had sprouted again, saplings reaching up ten feet; now that clump of greenery was twice as dense. He fluffed his fur to let the slight morning breeze ruffle it like leaves, and adjusted his two pair of ears at odd angles.

Presently the women and children came staggering into sight. They were exhausted, but almost the only sound they made was their breathing. There was no clearing here, but they sank to the ground, scattered well out, to rest in the cover. A woman with a baby just old enough to walk lay wearily down at Hunter's paws.

The baby was not tired; he had been carried. He sat up and looked around happily, but without making a sound. All of them were silent—the older children with anxious white faces, the younger ones happy or merely unhappy, or sleepy. An anticipatory tremor ran through Hunter as he stared down through thick eyelashes at the baby before him—just at his favorite age. But he sat motionless for ten minutes, until a man entered the

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thicket and spoke in a guarded tone.

"They don't seem to be following. Maybe they've gone. Stay here until we find out what's happened."

The women and children relaxed, and the boy in front of Hunter took it as permission to stand up, clinging to his mother's hair. He looked around, then up at the leaves overhead.

The dons were waiting for the men, but Hunter's guard relaxed and his ears came together alertly as he looked eagerly down. His glowing eyes opened a trifle wider. The boy's untrained eyes, with that hint, were able to put together the massive head looming over him. He laughed up and pointed, and his mother humored him by looking up too—a little anxiously.

In that company, a gasp was the equivalent of a scream. She gave one choked word of warning and started to gather up her son—understandably: the dons had not had time to clean up after the latest fight. The man who had spoken to them reappeared with another, and Hunter had no time to spare for the women and children.

After one startled look—everybody knew there were no big, dangerous animals on any planet of the Realm—the man stood firm. He was edging his curious weapon around, though, Hunter noticed as he stepped down carefully, placing one great paw beside the frozen woman and her son—now also frozen with her fear. He glanced aside at them and flicked his right ears politely. (The spot between the big one and the little one had not been properly scratched in weeks . . .)

Fixing his eyes on the man's steady gray ones, he paced deliberately forward. This one looked like the kind of man an arborodon could follow with complete confidence. A spot inside him, tense since the landing, began to relax. Behind him he could feel the others, eyes fixed tensely on that weapon, hoping, yet ready to launch themselves in furious attack in his defense. Every moment brought the rest of the cautiously investigating men closer to the helpless Silence, but there was no way this could be rushed.

The man had not attempted to point his stick at Hunter. Hunter cocked both sets of ears at him alertly—surely he could not mistake a plain question—and padded smoothly up to him, head high. He was all too conscious that he was as physically incapable of speaking the man's language as the man was of speaking Hunter's: the best he could do was to nod, shake his head, or lift a paw in a shrug.

Arborodon-speech had been enough on one historic occasion. But was this man, steady as he had already proven himself to be, the equal of the fabulous, still-remembered Christopher Loring?

Hunter offered his paw in the ancient, formal human custom and

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said, politely, "Er-ROO-um-mm."

The official decision of the Archate was that the spy had perished in the wilderness. He might have been killed by the disinherited animals; they were justly suspicious of strange men. In any case, he was never found, though hundreds of square miles of forest were searched as minutely as only two competitive Archons can. On the other hand, he never succeeded in making contact with anyone on Hyperica, or doing any damage. Unofficially, he might still be alive, living with the disinherited animals; if so, it was a suitable place for him. He certainly did not threaten the Realm.

Both Teodor and Rupert were removed from their posts in the Archate, though not actually degraded. So much was positive gain. Ronnel was merely censured for not having the pseudo-meteorite inspected; he might also have been dismissed if there had not been others who had blundered worse. In addition, he now enjoyed the alliance of the old Archon, Verbert.

"It might have been very bad for everyone concerned—even myself—if that spy had done any damage," said the other shrewdly.

Ronnel could afford to shrug at that. True, he had had to sacrifice Captain Wilnson and the possibility of another coup to scotch the rumors of there being a connection between the man and the spy—and perhaps himself. Rupert had been nasty and Teodor venomous in their accusations. Wilnson should have known better than to jog the field party's mental elbows; it gave away the fact that he had led them into the ambush. He had been sent home. Too bad he hadn't had time to fix up enough proof against him to blind the eyes of the Empire enough so he could have been arrested. But he still had a near monopoly on contact with the Empire and other planets.

"What do you think his mission here was?" asked Ronnel uneasily.

"Well, foolish as it sounds, I suspect that his business was to contact, if that's the word for it, the animals in the wilderness. What the Empire hoped to accomplish is obvious; in view of what they must surely know about us—particularly now that Captain Wilnson has made out his report—it seems particularly obtuse. Most of the others seem to agree," he added as Ronnel nodded.

"He's as good as dead, in that case; his mission a complete waste of time," agreed Ronnel, frowning. As he had been under a cloud, he had not been permitted to take part in the deliberations of the Archate.

He sipped his seonana, set it down, looked uneasily at the older man. "I wonder," he mused. "Doesn't this have a strange air to you?"

"No, not really. It's about what I might expect of the Empire.

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We're not an easy nut to crack."

"True. But this situation leaves me with an uneasy feeling. Remember you thought it was a feint, and your logic still holds." He thought a moment, said, "Do you know anything about poker?"

"That's the game with cards that young fellow—forget his name—invented for his historical novel, isn't it? No, he dug it up out of some old records."

"Yes. You've read the novel? You remember there was a fight when the hero discovered that one of the others had played one card —a powerful card called an ace—not long after one of the others had played it. The cards had been randomized between the plays, but his calculation both of the odds in the game and of the other's character convinced him that the other had had that one hidden out. On rapidly counting the cards in the deck when he took it in turn, he found one more than there should have been; and knew that there were five aces in it."

The other was nodding intently.

Ronnel said, "I have the same feeling he had on seeing that fifth ace turn up. Like him, I have no proof; unlike him, I cannot count the cards in the deck. But I feel that there is more to this incident than is obvious."

"It's possible, I suppose," said the other slowly. "But if so," he added, less seriously, "we should soon know." ■

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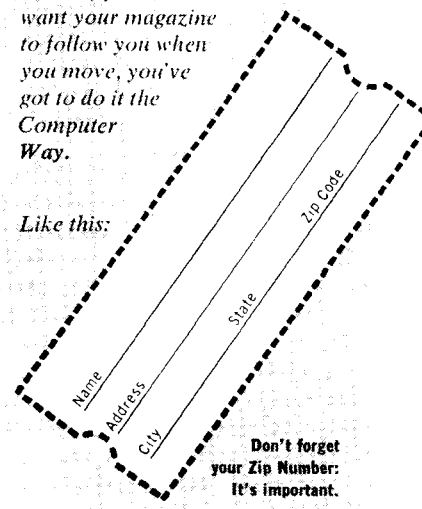

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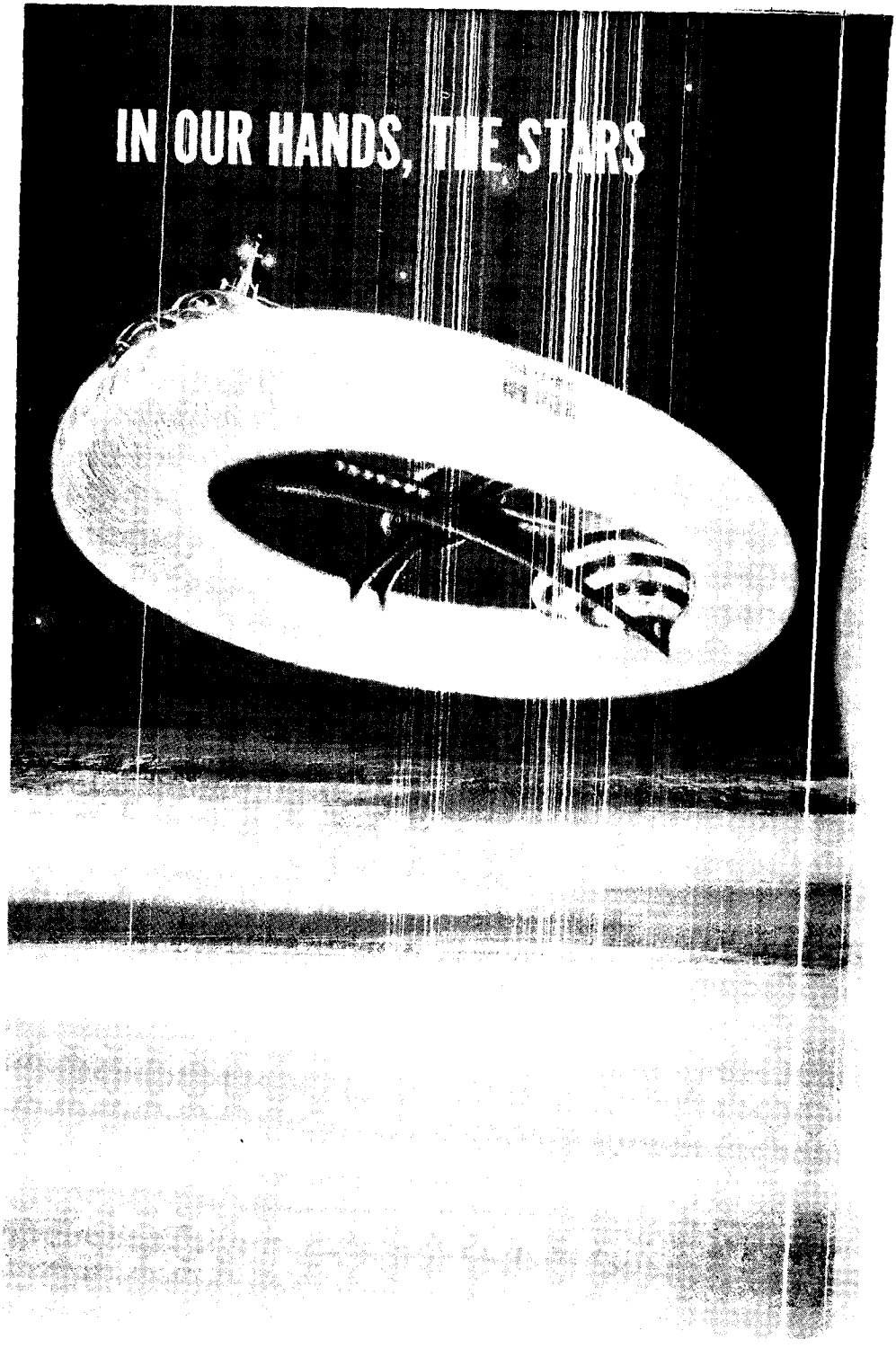

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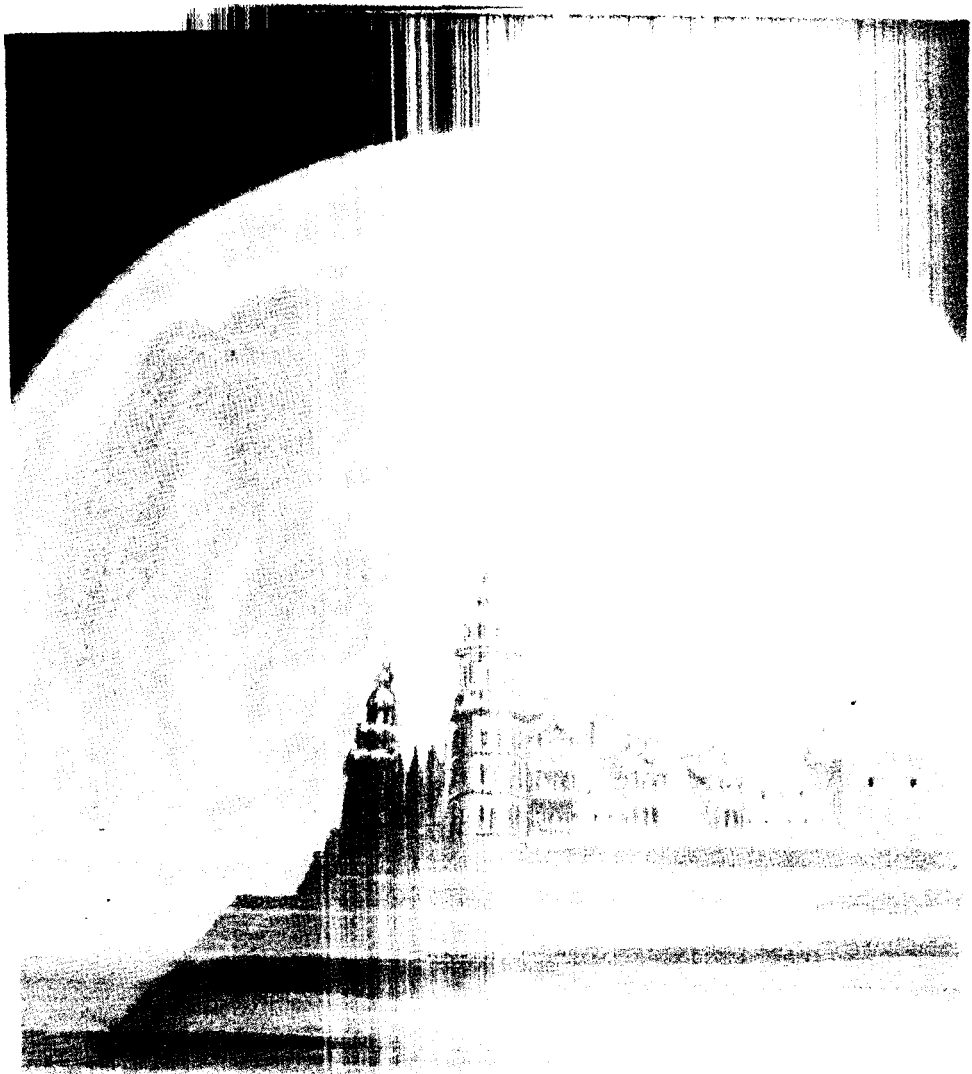

Conclusion.
Inevitably, the Dyson effect ships were the target of
every national security apparatus—the irresistible attraction.
And because all security forces have a deep belief
in the reality of secrecy—none of them
foresaw the inevitable end . . .

HARRY HARRISON

Illustrated by Kelly Freas

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PROFESSOR ARNIE KLEIN has an experiment destroyed by an explosion in his laboratory in Israel. He knows that he has discovered something terribly important and he leaves at once for Denmark. His movements are traced by the Israelis who send GENERAL AVRI GEV to demand an explanation. ARNIE reveals that he has made a discovery that could easily be used as a weapon of destruction. He has, therefore, brought it to Denmark, where he was born, to be developed in a peaceful manner as a power for peace. GEV does not think much of this unilateral, even traitorous, action—but there is nothing he can do about it.

ARNIE, with his old friend and scientific associate OVE RASMUSSEN, develops his Daleth drive. It is demonstrated secretly and succeeds in lifting an entire icebreaker into the air. This is only the beginning. The real possibilities of the discovery are shown when an experimental submarine is fitted with the drive and the sub rises above the Earth's atmosphere. It is crewed by ARNIE, NILS HANSEN the top SAS pilot, and HENNING WILHELMSEN a submarine commander. The Daleth effect provides a true space drive that can operate continuously, first for acceleration, then deceleration. A spaceship fitted with the drive can go to the Moon in less than four hours, to Mars in less than two days. The impact of this discovery will be enormous on everyone.

Although the development of the drive has been kept a tight security secret it is already being investigated by other nations. Even though Denmark is a NATO partner, the United States knows nothing about the Daleth effect. CIA man BOB BAXTER wants to know more. As does LIDIA SHIROCHENKA his opposite number at the Soviet Embassy. They both employ HORST SCHMIDT, an experienced spy and double agent.

OVE RASMUSSEN has developed a fusion generator that could be used to power the Daleth drive in space. They are considering this just as there is an announcement that there has been a tragic accident. The three members of the U.S.S.R. lunar expedition, NARTOV, SHAVKUN and ZLOTNIKOVA, are uninjured—but they are trapped on the Moon. They will die there since there are no rescue rockets available anywhere in the world.

But there is the tiny submarine, Blæksprutten, *and the Daleth drive. The Danes do not wish to reveal the existence of the drive yet, but they must in order to save the cosmonauts. It is the humanitarian thing to do. The sub is quickly readied and ARNIE, OVE and NILS take it to the Moon. They arrive just as COLONEL NARTOV is making his farewell speech. The cosmonauts are saved—so the*

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drive will no longer be a secret. What will the world reaction be?

The pressure begins. The double agent, HORST SCHMIDT, breaks into a government office to search the files and kills a nightwatchman who discovers him. All of the security agents in the world are after the secret, their attention focused on the atomic institute in Copenhagen. They do not yet know that a special kind of ship is being built in the Elsinore shipyard that will use the Daleth drive. MARTHA, NILS HANSEN'S wife, is an American citizen, and the CIA man BOB BAXTER attempts to enlist her aid. She is frightened but will not help him.

However the Americans are not the only ones interested in the drive. A raid is made on the Daleth ship in Elsinore and ARNIE is kidnaped. The spies are surprised and stopped by NILS and SKOU, the Danish security man. The spies are dead and no one knows what country they represented—but the message is clear. The ship has been discovered. The shipyard is put under a heavy guard and the work is rushed so that the ship can be launched quickly. The Daleth ship is christened GALATHEA *and goes at once to Copenhagen where the Daleth drive is installed.*

MARTHA has been kept in the dark, and when she hears about the launching she goes to Copenhagen to see what is happening. She is met there by BOB BAXTER who finally enlists her active aid on his side—as the GALATHEA *makes an unannounced and surprising take-off for the Moon.*

What has happened is explained on a world-wide television broadcast from the Danish Moon base. There were too many spies and too much killing for the secret of the Daleth drive. So all of the files, records, men, materials—everything to do with the drive has been taken to the Moon where it is beyond the reach of the other countries. The Danes want only to develop the commercial possibilities of the drive, not the warlike ones, and they ask the world to cooperate. The Daleth effect can be the most terrible weapon ever discovered if it is misused, which is why ARNIE brought the secret to Denmark, and why it is now being kept from the other nations.

But secrets are hard to keep. ARNIE and NILS come back to Earth, for a short rest at NILS'S home in Denmark. By chance NILS meets an old girl friend, INGER AHLQVIST, and on the impulse of the moment they fall into each other's arms and into bed. Where, unknown to them, they are discovered by NILS'S wife MARTHA.

MARTHA is angry and hurt, and when she sees ARNIE'S notebook full of equations she grabs the opportunity. She photographs the secret information to turn over to BOB BAXTER.

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Part 3

XVIX

The big Jaguar moved steadily north along the coast, staying exactly at the posted speed limit. Nils drove easily with one hand while he tried to find some music on the radio.

"We are starting out a little late," he said. "Do you have to stop in Helsingør?"

"I have to go to the post office. It will take only a minute," Martha said.

"What's so important?" He found a Swedish station that was playing a peasant polka.

"I have to send off some film for developing."

"What's wrong with the photography shop next to the grocer in Rungsted?"

"They're too slow. This is a special place in Copenhagen. If you think I'll make you late just drop me off by the ferry and you can go on by yourself."

He took a quick look out of the corner of his eye, but she was looking ahead, her face expressionless.

"Come on! This is a holiday—of course I'll wait. I just don't want us to miss the launching, or ascension or whatever you want to call it. You'll love it. These tugs will just drift down and latch onto the ship and lift it right up out of the ways. They'll install the drive on the Moon."

They had to wait at the ferry slip while the fussy little steam engine pulled a string of Swedish boxcars across the road.

"Look at that yard donkey," Nils said. "Leaking steam and oil from every joint—and still dragging trains off the ferry. Do you know how old it is?" Martha apparently did not know, nor did she appear too interested in the answer. "I'll tell you. It's on that plate on the side of the cab. 1892 that antique was built, and still on the job. We Danes never throw anything away while it still works. A very practical people."

"As opposed to we Americans who build cars and things to break down at once and be discarded?"

He did not answer, but drove past the station and turned down Jernbanevej to the post office at the rear of the terminal. He parked and she got out, carrying the small package. Film. He wondered how long she had had it in the camera. She certainly had not taken any pictures since this holiday began. Some holiday. He wondered what could possibly be bothering her; he could think of nothing. He saw that he had parked next to a hot-dog stand, and his stomach gave an interested rumble at the sight. They would be sure to have a late lunch and he ought to be prepared. He went in and ordered two of them, raw onion, ketchup and mustard—then canceled the onion when he remembered that they

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would be at the launching with all the politicians and bigwigs. He had to remember this place, they had beer, too, so he washed the *pølser* down with a cold bottle of Tuborg Gold.

What was the matter with Martha? She was not unresponsive, but there was a coldness that made her turn away from him at night. Perhaps it was the tension of the Moon flights, the sabotage and all that. You never could tell about women. Funny creatures. Given to moods. He saw her coming out of the post office and hurriedly finished the beer.

Nils never had a moment of doubt. Nor had he once, ever since that Sunday afternoon, ever even thought about Inger.

XX

It was almost noon, and here on the equator, at midsummer, the temperature had shot up to almost thirty degrees below freezing. The hill, really one flank of a great circular crater, rose up sharply from the plain. A much shrunken sun glared down on the frozen landscape from a black sky, where the brightest stars easily could be seen. Only at the horizon was the atmosphere dense enough to trace a thin line of blue against the sky. The air was still, with a timeless silence, so thin, almost pure carbon dioxide, that it was almost not air at all. And very, very cold.

The two men climbing the steep slope had hard going, despite the lower gravity. Their heavily insulated, electrically heated clothing hampered their movements; their battery packs and oxygen tanks weighed them down. When they reached the crest they stopped, gratefully, to rest. Their features were hidden by their masks and goggles.

"That's . . . quite a climb," Arnie said, gasping for breath.

No expression could be seen on Nils's shrouded face, but his voice was worried. "I hope it wasn't too much. Maybe I shouldn't have brought you?"

"Fine. Just out of breath. And out of shape. It has been too long since I have done anything like this. But it is worth it, really, a simply magnificent sight."

The silent landscape reduced them, too, to silence. Chill, dark, alien, a planet that had not died because it had never been born. The tiny settlement below was like a welcoming light in a window, a single touch of warmth in the eternal cold of Mars. Arnie looked around—then stepped quickly aside beckoning Nils after him.

"Is anything wrong?" Nils asked.

"No, not at all. We were just standing between the sun and this Mars-kål. It is starting to close up. It thinks that it is night again."

The foot-long and widespread, starfish-like arms of the animal-plant were half closed, revealing

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the rough, grayish underside. When completely closed they formed a ball, insulated against this incredibly harsh environment, holding tight to the minuscule amount of heat and energy it had obtained, waiting for the sun to return once again. When it did the arms would unfold to reveal the shiny black plates of their undersides, that captured and stored the radiation from the far distant sun. This tough growth was the only form of life discovered yet on Mars and, although its nickname "Mars cabbage" was now the official title, it was looked upon with respect, if not with awe, by all of them. This was the only Martian. Both men stood carefully aside so that the sunlight could fall on it again.

"It reminds me of some of the desert plants in Israel," Arnie said.

"Do you miss Israel?" Nils asked.

"Yes, of course. You do not have to ask." Because of the thin atmosphere his voice was a distant whisper, despite the fact he was talking loudly.

"I imagine you would. I know a lot of countries, and most of them look a lot more interesting than Denmark when first you fly in. I could live in any of them, I suppose, but I would still pick Denmark. I wouldn't like to leave. I sometimes wonder how you managed to pack up and leave Israel on principle. I doubt if I could do a thing like that. Doubt if I would have the guts to do it myself." He pointed. "Look, there it is, just like I told you. You can see the entire area from up here. There are the new buildings, just going up, and the landing area laid out beyond *Galathea*. When they will be needed more buildings can be constructed along the eastern side. There is going to be an entire settlement here—a city some day. The railroad will go from right down there to the mountains where the mines will be."

"A very optimistic project. But there is certainly no reason why it should not work out that way." But Arnie was thinking about what Nils had said. About Israel. It was a topic that he worried to himself, like a sore tooth, and he could not stay away from it. Although he rarely talked about it to anyone else. "What did you mean, exactly, when you said that what I did took guts? I did only what I had to do. Do you think that it was wrong—that I owed Israel loyalty ahead of all mankind!"

"Hell, no!" the big pilot said, and managed to get a boom of warmth into the whisper of his audible voice. "I'm on your side, don't ever forget that. What I really mean is that I admire what you did, not selling out. If what you say is true, then staying would have been the big sellout. The same way that scientists have been selling out since the word science was invented. Bombs, poison gas and death for the sake of my fatherland.

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That's the direct sellout. Invent the atom bomb—then moan about the way it is being used but don't stick your neck out. The indirect sellout. Or the wool-over-the-eyes sellout—I'm working on nerve gases, germ warfare, bigger bombs, but they never will be used. Or the world-is-too-big-for-me to do anything, sellout, the one everyone uses. Chemists make napalm to cook people. But I can't stop buying their products—it won't make any difference. South Africa has the best police state in the world and a country full of legal Negro slaves. But I'll still buy their oranges, what can I do? You can blame yourself for how I feel, Arnie."

"What on Earth—I mean what on Mars—do you mean?" He stamped his feet as the cold began to seep through the soles of his boots.

"I mean that you did what I think I would not have had the guts to do. You stuck by your convictions, no matter what your personal loss. There have been all kinds of South Africa boycotts in Denmark and I ignored them. Or laughed at them. What could *I* do? I flew and I lived well and I enjoyed myself. But you got under my skin, showed me something different—"

"Stop!" Arnie said, shocked. "You don't realize what you are saying. I did a traitorous thing, betraying my country and her trust in me and depriving her of the results of the research that rightly belonged there. I went outside the law. If a scientist can be said to have an oath, I have surely violated mine."

"I don't understand—"

"I am sure you don't. Your view is one-sided, unthinking, even more biased than mine. I admit my crime. Yet you offhandedly blame all scientists for all the sins of the world. You speak of atomic bombs. But what of atomic power plants and radioactive medicines? You blame scientists for inventing explosives, but don't talk about the plastics that stem from the same chemical fundamentals. You speak of bacterial warfare, but not about the virus-killing medicines that came from the same research. You may try, but you cannot truly blame science and scientists for the world's ills. We physicists may have made the atom bomb, but it was the government that financed it and elected politicians who decided to drop it.

"*Knowledge is power*—but it is neither good nor evil. A technological device is like a knife; whether the knife is used as a scalpel to cure, or as a dagger to kill, has nothing to do with the knife—or the blacksmith who forged it. It is solely the responsibility of the wielder.

"Physicists invented the nuclear reactor; they made the first one

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during wartime—but it would have been made soon whether the war had come along or not. And you can be certain that the next war that did come along would find atomic explosives used as weapons —and any scientist who refused his country's demand that he build them would have been violently attacked as a traitor by the press, from the pulpit, and in government houses and in every street-corner bar.

"Look what happened to Dr. Oppenheimer for expressing his reluctance to carry on and build the thermonuclear bomb! A massive campaign of vilification—because he was reluctant to do what people now angrily insist scientists shouldn't have done!

"It is the old, old human story—we demand what we want, then damn others for the consequences of our demands that we did not want.

"That is so old that it's the basis for the ancient fairy stories about three wishes. One wish to discover he has the power to get his wishes. One careless wish in anger. And—and this is what makes it a fairy story!—another wish that cancels the harm he did.

"That's what people want—and damn scientists because only the second wish is granted.

"Scientists don't make war—*people* do. If you try and blame the scientists for the condition of the world you are just using them as scapegoats. It is far easier to blame another person than to admit one's own guilt. Remember what Machiavelli said, about the fact that a Prince could not rule in the face of the active opposition of the people. The Nazis did not exterminate the Jews—the German people did. People have the responsibility of their deeds, but they do not like the weight of this responsibility. They, therefore, chose to blame others. They say that the scientists, who invented bombs and planes and guns, are responsible for the state of the world today. But the people who elect the politicians who make the wars are blameless. Do you really think that it is that way?"

Nils was shocked at the sudden anger. "I didn't mean it like that. I just said I admired—"

"Don't admire a man who has betrayed his country's trust in him. Even if my decision proves correct I have still done an unforgivable thing."

"If you feel this way—why did you leave Israel at all and come to Denmark? I know that you were born in Denmark and grew up there. Was that the reason why?"

The Martian silence closed in for long seconds before Arnie spoke again.

"Perhaps. Or perhaps because of faith—or hope. Or maybe because I am a Jew. In Israel I was an Israeli. But everywhere else in the

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world I am a Jew—except in Denmark. There are no Jews in Denmark—just a lot of Danes of varying religious faiths. You were just three or four years old when the Nazis marched across Europe so it is only history to you, another chapter in the thick books. They were monsters—demons in that they could unlock the evil in other hearts as well as their own. The people in the countries they conquered *helped* them fuel the ovens. The French police went out and arrested Jews for them. The Ukrainians happily fed the furnaces for them. The Poles rushed to see their Jewish neighbors cooked, only to be melted down themselves for their loyalty. Every invaded country helped the Germans. Every country except one. In Denmark the police were shocked to hear of the coming purge. They passed the word to others who were equally horrified. Cab drivers cruised the streets with telephone books, looking for people with Jewish names. Boy scouts passed the warnings. Every hospital in the land opened its doors to the Jews and hid them. In a few days every Jew who could be reached was smuggled safely out of the country. Do you know why the Danes did this?"

"Of course!" He clenched his large fists. "Those were human beings, Danes. That sort of thing just isn't done."

"So—you have answered your own question. I had a choice and I made it. I pray that I was right."

Arnie started down the hill, then stopped for a moment.

"I was one of the people smuggled out to Sweden. So perhaps I am repaying a debt."

They went down, side by side, to the light and warmth of the base.

XXI

"There's no point in our taking both cars," Martha said into the telephone. "We can fight about which one later, all right. Yes, Ove. Is Ulla ready? Good. I'll be there, in about an hour I guess. Yes, that should give us plenty of time. We have those seats in the reserved section and everything, so there shouldn't be any trouble. Listen, my doorbell just rang. Everything's all set? See you then."

She hung up hurriedly and went to get her housecoat as the bell rang again. All she had to do was finish her face and put her dress on—but she wasn't going to answer the door in her slip.

"Ja, nu kommer jeg," she called out, hurrying down the hall. When she opened the door she stopped halfway, as soon as she saw the pendant bundle of brushes; a door-to-door peddler.

"Nej tak, ingen pensler idag."

"You had better let me in," the man said. "I have to talk to you."

The sudden English startled her

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and she looked past the well-worn suit and cap, at the man's face. His watery blue eyes, blinking, red-rimmed.

"Mr. Baxter! I didn't recognize you at first—" Without the dark-rimmed glasses he seemed a totally different man.

"I can't stand at the door like this," he said, angrily. "Let me in."

He pushed towards her and she stepped aside to let him by, then closed the door.

"I have been trying to contact you," he said, struggling to disentangle the bundle of whisk brooms, hair brushes, feather dusters, toilet brushes so he could drop them on the floor. "You have had the letters, the messages."

"I don't want to see you. I've done what you want, you have the film. So stop bothering me." She turned and put her hand on the knob.

"Don't do that!" he shouted, sending the last brush clattering against the wall. He groped in his inner jacket pocket and found his glasses. Putting them on he drew himself up, became calmer. "The films are valueless."

"You mean they didn't come out? I'm sure I did everything right."

"Not technically, that's not what I'm talking about. The notebook, the equations, they had nothing to do with the Daleth effect. They are all involved with Rasmussen's fusion generator and not what we want at all."

Martha tried not to smile—but she was glad somehow. She had done as she had been asked, she had struck out. It was not her fault about the notebook.

"Well, can't you steal the fusion generator? Isn't that valuable?"

"This is not a matter of commercial value," Baxter told her coldly, a good deal of his old manner restored. "In any case the fusion unit is being patented, we can license the rights. What you and I are concerned with is national security, nothing less than that."

He glared at her and she pulled the edges of her housecoat more tightly around her.

"There's nothing more I can do for you. Everything is on the Moon now, you know that. Arnie's gone, too—"

"I'll tell you what you can do, and there's not much time left. Do you think I would have gone out on a limb with this rig if things were not vital—"

"You do look sort of foolish," she said, and tried not to giggle.

Baxter gave her a look of pure, uncut hatred, and it took him a moment to control himself. "Now you listen to me," he finally said. "You're going to the ceremony today, and you will be going aboard the ship afterwards and there are things we need to know about it. I want you to—"

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"I'll do nothing for you. You can leave now."

Martha reached for the doorknob as he took her by the arm.

"Listen you, you are going to do like I say. If you want a reason other than loyalty to your country—just remember that I have a roll of film from your camera with your fingerprints all over it, and pictures of your floor. The Danes would love to see that, wouldn't they?" The silence lengthened.

"What do you want me to do?" she asked, finally, looking at the floor as she said it.

"That's more like it. You're a great camera addict, so take this brooch. Pin it onto your purse before you go."

She held it in her palm; it was not unattractive and would go well with her black alligator. A large, central stone, was surrounded by a circle of diamond chips, and what could be small rubies. It was finished in hand-chased gold.

"Point your purse and press here," he said, indicating the top whorl. "It's wide angle, the opening is preset, it will work in almost any light. There are over a hundred shots in here so be generous. I want pictures of the bridge and the engine room if you get there, close-ups of the controls, shots of hallways, stairs, doors, compartments, air locks. Everything. Later on I will show you prints and you will be asked to describe what they are, so take close notice of everything and the sequence of your visit through the ship."

"I don't know anything about this kind of work. Can't you get someone else, please? There will be hundreds there—"

"If we had anyone else—do you think we would be asking *you?*" The last word was spoken with cold contempt, thrown at her as he bent to pick up the brushes. He shook a dishmop in her direction.

"And don't go making little accidents like dropping it, or breaking it, or exposing all the film in the dark and blaming us. I know all the tricks. You have no choice. You will take the pictures as I have told you. Here, this is for you." He handed her a brush, smiling, coldly, sure of himself. He opened the door and was gone.

Martha looked down at it—then hurled it from her. Yes, that's what he thought. A toilet brush. She was shaking as she went to finish dressing.

"Look at the crowds!" Ove said, steering around a busload of cheering students who were waving flags from all the windows.

"Can you blame them?" Ulla asked. She was sitting in the back of the car with Martha. "This is certainly a wonderful day."

"Weather, too," Ove said, glancing up at the sky. "Plenty of clouds,

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but no rain. No sun—but you can't have everything."

Martha sat silently, clutching her purse, the big gold brooch prominent on the flap. Ulla had noticed it, and she had had to make up a quick lie.

It would have been impossible to get close to the water front if they had not had their official invitation. They were waved through the barriers and directed to Amalienborg Palace where the immense square had been sectioned off for parking. From there it was a short walk down Larsens Plads to the water's edge. There was a holiday air, even here, with a band playing lustily, bunting flapping on the stands erected on the dock, the guests nodding to each other as they took their places.

"Ten minutes," Ove said, looking at his watch. "We had better hurry. Unless Martha thinks her husband will be late?"

"Nils!"

They all laughed at the thought, Martha along with the others. For seconds at a time she would feel right at home here, being ushered to her seat—not ten feet from the King and the Royal Family—smiling happily at friends. Then memory would return with a sinking in her midriff, and she would clutch at her purse, sure that people were looking at it. Then the band broke into "King Christian," the Royal Anthem and there was a great rustling as everyone rose. After that the National Anthem, "There is a Lovely Land", terminating with a great flourish on the drums. The last notes died away and they sat down and, at almost the same instant, a distant whistling sound could be heard. They all looked up, shielding their eyes, trying to see. The sound deepened, turned to a rumble, and a dark speck broke through the layer of clouds high above.

"Right on time, to the second!" Ove said, excited.

With startling suddenness the dot grew, enlarged to giant proportions, appearing to fall straight towards them. There were gasps from the audience, and a choked-off scream.

The speed slowed, more and more, until the great shape was drifting down as softly as a falling feather, dropping towards the still water of the Inderhavn before them. There were more gasps as its true size became obvious. The great white and black hull was as big as any ocean-going ship, thousands of tons of dead weight. Falling. There was something unbelievable about its presence in the air before them. An immense disk, half a city block long, flat on top and bottom, with the windowed bulge of the bridge protruding from the leading edge. It had no obvious means of propulsion; there was no sound other than the air rushing around its flanks.

Absolute silence gripped the on-

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lookers, so hushed that the cries of the sea gulls could be heard clearly. The great ship came to a complete halt, airborne, a few meters above the water. Then, with infinite precision, it dropped lower. Easing its tremendous bulk into the water so carefully that only a single small wave eased out to slap against the face of the wharf. As it moved closer hatches opened on its upper decks and men brought out lines to secure it.

A spontaneous cheer broke out as the onlookers surged to their feet, shouting at the top of their lungs, clapping, the enthusiastic music of the band drowned out by their joyous noise. Martha shouted along with the others, everything else forgotten in the wild happiness of the moment.

In strong black letters, picked out against the white, the ship's name could be clearly read. *Holger Danske*. The proudest name in Denmark.

Even before the lines were secured, a passenger ramp was pushed out to the opened entrance. Some prominent officials were waiting to welcome the officers who strode down to them. Even at this distance Nils's great form was clearly visible among the others. They saluted, shook hands, and came forward to the reviewing stand. Nils passed close enough to smile when Martha waved.

After that there were honors and awards, a few brief words from the King, some longer speeches from the politicians. It was the Prime Minister who made the official pronouncement. He stood, for a long moment, the wind whipping free strands of his hair, looking at the great ship before him. When he spoke there was a heartfelt sincerity in his words.

"In the old legend, Holger Danske lies sleeping, ready to wake and come to Denmark's aid when she is in need. During the war the resistance movement took the name Holger Danske and it was used with honor. Now we have a vessel by that name, the first of many, that will aid Denmark in a way no one ever suspected.

"We are opening up the solar system to mankind. This accomplishment is so grand that it is almost beyond imagining. I like to think about the seas of space as another ocean to be crossed, the way Danish seafarers crossed in the Nineteenth Century, with new and fantastic lands on the other side. Science shall profit, from the observatory and the cryogenic laboratories now being built on the Moon. Industry shall profit, from the new sources of raw materials waiting for us out there. Mankind shall profit, because this is a joint venture of all the nations of the world. It is our fondest hope that the cause of peace shall profit—because out there, in space, our world is small and veiled and far

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away. Looking from there it is hard to see the separate continents while national boundaries are completely invisible. Vital evidence that we are one world, one mankind.

"Denmark is too small a country to even attempt to exploit an entire solar system—even if we so wished. We do not. We eagerly seek the cooperation of the entire world. In two days *Holger Danske* will leave on the first voyage to Mars with representatives of many nations aboard. Scientific facilities are under construction there, and scientific workers from a great many countries will remain behind on the red planet to begin a number of research projects. The political representatives will return to tell the people, in their own countries, what the future will be like. It will be a good one. As Danes we are proud to be able to bring it about."

He sat down, to a thunderous applause, and the band played. The television cameras took in everything while the announcement was made that the guests could now visit the spaceship.

"Wait until you see it," Ove said. "The first ship ever designed for this job—and no expense has been spared. It is basically a cargo ship, but the fact is well disguised. The entire interior section is made up of cargo holds, with the operating compartments of the ship forward. Which leaves all of the outside for cabins. Each one with a porthole.

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Luxury, I tell you. Come on, before the press gets too heavy."

Entrance to the ship was through the custom hall that was used when the Oslo ferry normally tied up at this pier. And the customs officers were still there—still doing their usual jobs. No packages were allowed aboard, briefcases and containers were being checked in. With utmost politeness, the men who were boarding were asked to show the contents of their pockets, the women turned out their handbags. There might be complaints, but high-ranking police and Army officers stood by to handle them quietly. There were even an admiral and a general, chatting with a departmental minister and an ambassador, in a small room to one side. The theory was obviously to have someone of equal—or greater—rank to handle any complaints.

There were none. A few raised eyebrows and cold looks at first, but the Prime Minister led the way by turning out his pockets and showing the contents of his wallet. It had obviously been staged that way, but was important nevertheless. The safety of the *Holger Danske* was not to be compromised.

As the line moved forward slowly, Martha Hansen found herself paralyzed with fear. She surely would be discovered and disgraced. There was no place to run and hide. Stumbling, she could only follow the others. Ulla was saying something, and she could only nod dumbly in answer. Then she was at the counter and a tall, stern-faced customs officer was facing her. He slowly reached his hand out.

"This is a great day for your husband, Fru Hansen," he said. "Might I—?" He gestured towards her purse. She extended it.

"If you will just open it," he said.

She did so, and he poked through it.

"Your compact," he said, pointing. She handed it to him and he snapped it open, closed and returned it.

The glittering eye of the camera brooch pointed directly at him. For a long moment he looked at it, smiling.

"That is all, thank you," and he turned away.

The Rasmussens were waiting, and Nils was waving from the deck above. She raised her hand, waved back. They went aboard.

Martha with her purse held before her, one finger on her new brooch, wondering what she would say to Nils if he noticed it. She need not have worried about it. Normally the calmest of men while on duty, he was not so today. He had his hands clasped behind his back—perhaps to calm them—but his eyes were bright with excitement.

"Martha, this is the day!" he

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said, embracing her, lifting her free of the deck for a moment while he kissed. With passion. She was dizzy when he put her down.

"My goodness—" she said.

"Have you seen this giant of a barge? Isn't she a dream? There has been nothing like it since the world began. We could carry poor little *Blaeksprutten* as a lifeboat, honestly! The best part is that this is not a makeshift or a compromise, but a vessel designed only for use with the Daleth drive. My bridge is right out in the leading edge for lateral movement, just like an aircraft, yet has full visibility both up and down for acceleration and deceleration. Come on—let me show it to you. All except the engine room, that's locked up while visitors are aboard. And if we had the time I would show you my bedroom as well as my cabin," he put his arm about her as they walked. "Martha, after flying this beauty everything is changed. I think now that flying the biggest aircraft would be like, I don't know, like pedaling a kiddy car. Come on!"

As they walked through the open space lock her finger touched the golden whorl on her brooch and she felt it depress slightly.

She hated herself.

XXII

"Aren't they all aboard yet?" Arnie asked, looking out at the wharf from the high vantage point of the bridge. Two men came out of the customs shed, bending over and holding their homburgs down with their hands as the Baltic wind whipped around them. The porters, with their suitcases, came after them.

"Not yet, but we should be nearing the end," Nils told him. "I'll check with the purser." He dialed the office in the entrance hallway and the small telephone screen lit up with a full-color image of the chief purser.

"Sir?"

"How is your head count going?"

The purser consulted his charts, ticking them off with a pencil. "Six more passengers to go, and that's the lot."

"Thanks." He hung up. "Not too bad. Considering that they are doing everything but X ray them and examine the fillings in their teeth. I suppose that I'll be hearing plenty of complaints. Ship captains never appear among the passengers until after the first day at sea. I think maybe I'll try that."

"With the new computer setup I imagine that you do not have to worry about your exact take-off time?"

"There's nothing to it." He patted the gray cabinet of the computer readout near his pilot's position. "I tell this thing when I want to leave and it gets the answer back almost before we're

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through typing. While we are in dock it is plugged into a direct land line to Moscow. After take-off our computer talks to theirs and there are constant course and velocity checks and corrections."

They watched another late arrival hurry across the wharf.

"Were the Americans upset about our using the Soviet computer?" Arnie asked.

"I suppose so, but they couldn't complain because we had no simple line connection to theirs. But we are using only U.S. spacesuits so it evens out. Done on purpose, I'm sure. How was Ove when you saw him?"

Arnie shrugged. "Still in bed, coughing like a seal, still with a fever. I waved from the door, he would not let me come in. He wished us the best of luck. The flu went to his chest."

"I'm glad you could take his place—though I'm sorry we had to ask you. As soon as all the bugs are ironed out we won't be needing physicists in the engine room any more."

"I do not mind. In fact I enjoy it. Research and teaching are going to be very tame after some of these flights. Like *Blæksprutten* to the Moon—"

"With the telephone box welded to the hull! God, those were the days. Look how far we have come." He waved around the expanse of the bridge, at the uniformed crewmen on duty. The radio operator, talking to control ashore, the navigator, second pilot, instrumentation operator, computer mate. It was an impressive sight. The phone sounded and he answered it.

"All passengers aboard, Captain."

"Fine. Prepare for take-off in ten minutes."

Arnie was in the engine room for take-off, and in all truth he found very little to do. The crewmen were respectful enough, but they knew their jobs well. The Daleth drive had been automated to the point where the computer monitored it, and human attention was almost redundant. And the same was true of the fusion generator. When Arnie was hungry he had some food sent in, although he knew that he had been invited to the first-night banquet. That he would avoid, with good reason, since he loathed this kind of affair. He was only too glad to help out and to take Ove's place, when his friend was ill, but he did not really enjoy it. The laboratory at *Månebasen* interested him far more, the new line of research he had started, and the classes he held in Daleth theory for the technicians.

And then there were the passengers. He had the list and it did not take too much honesty to admit that this was the real reason why he stayed sealed in the operating section. He had found no friends or associates among the

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scientists, they were all second-rate people for the most part. Not second rate, that wasn't fair, but juniors—assistants to the important people. As though the universities of the world were not trusting their top minds to this unorthodox endeavor. Well, it did not matter. The young men could take observations as well as the old, and the raw facts and figures they returned with would have the others clamoring for a place on the next mission. Making a start, that was what counted.

As to the others, the politicians, he knew nothing about them. There were very few names he had ever heard before. But then, he was not the most careful of political observers. Probably all second consuls and that sort of thing, trying the water temperature this first trip so their betters could take a plunge later on.

But he knew one politician. He must face the fact—this was why he was staying away from the passenger section. But what good was it doing? General Avri Gev was aboard and he would have to meet him sooner or later. Arnie looked at his watch. Why not now? They would all be full of good food and drink. Perhaps he would catch Avri in a good mood—knowing that this was impossible even as he thought it. The entire voyage to Mars would take less than two days—and he was not going to spend all of the time hiding.

After checking with the technicians—no, everything was fine now, they would call him if there were any problems—he went to his cabin for his jacket, and then to the airtight doorway that led to the passenger section.

"Fine flight, sir," the master-at-arms said, saluting. He was an old soldier, a sergeant, obviously transferred from the army with all his stripes and decorations. He looked at his television screen that showed the empty corridor beyond, then pressed the button that opened the door. There were airtight doors throughout the *Holger Danske*, but this was the only one that could not be opened by hand from either side. Arnie nodded and went through, and found General Gev waiting for him around the first bend.

"I was hoping you would come out," Gev said. "If not I would have put a call in for you."

"Good evening, Avri."

"Would you come to my cabin? I have some Scotch whisky I want you to try."

"I'm not much of a drinker and I—"

"Come anyway. Mr. Sakana gave it to me."

Arnie stared at him, trying to read something from those impassive, tanned features. They had been talking in English. There was no one named Mr. Sakana. It was a Hebrew word meaning "danger".

"Well—if you insist."

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Gev led the way, showing Arnie in then locking the door behind him.

"What is wrong?" Arnie asked.

"In a moment. Hospitality first. Sit down, please, take that chair."

Like all of the cabins, this one was luxurious. The port, with the metal cover now automatically swung back after passing through the Van Allen belt, opened onto the stars of space. A hand-made Rya rug was on the floor. The walls were paneled with teak and decorated with Sikker Hansen prints. The furniture was Scandinavian modern.

"And color television in every cabin." Gev said, pointing to the large screen where cannon fired silently in a battle scene from the new film, "From Atlanta to the Sea." He took a bottle from the bar.

"It is practical," Arnie said. "As well as furnishing entertainment from taped programs. It is part of the telephone system as well. Did you get me here to talk about interior decorating?"

"Not really. Here, try this. Glen Grant, pure malt, unblended, twelve years old. I developed a taste for it while I served with the British. There is something wrong aboard this ship. *Loch heim.*"

"What do you mean?" Arnie held his drink, puzzled.

"Just taste it. A thousand percent better than that filthy slivovitz you used to serve. I mean just that. Wrong. There are at least two men among the Eastern delegation whom I recognized. They are thugs, known agents, criminals."

"You are sure?"

"Of course. Have you forgotten that I am charged with internal security? I read all the Interpol reports."

"What could they be doing here?" Abstracted, Arnie took too big a drink and started coughing.

"Sip it. I don't *know* what they are doing here, but I can readily guess. They are after the Daleth drive."

"That is impossible!"

"Is it?" Gev managed to look cynically amused and depressed at the same time. "Might I ask you what kind of security precautions have been taken." Arnie was silent, and Gev laughed.

"So don't tell me. I don't blame you for being suspicious. But I do not make a very good army of one, and the only other Israeli aboard is that round-shouldered *shlub* of a biologist. A genius he is supposed to be, a fighting man he is not."

"You were not this friendly the last time we talked."

"With good reason, as you well know. But times have changed and Israel is making the best of what she has. We don't have your Daleth drive—though at least it has a good Hebrew name—but the Danes are being far more accommodating than we ever expected. They admit that a lot of the Daleth theory was

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developed in Israel, therefore are giving us first priority in scientific and commercial exploitation. We are even going to have our own base on the Moon. Right now there is nothing to really complain about. We still want the Daleth drive but, at the moment, we don't intend to shoot anyone for it. I want to talk to Captain Hansen."

Arnie chewed his lip, concentrating, then finished the rest of the whisky without even realizing it. "Stay here," he finally said. "I will tell him what you have seen. He will call you."

"Don't be too long, Arnie," Gev said quietly. He was very serious.

Nils had made a short speech at the banquet, then retreated to the bridge pleading the charge of duty. He was sitting, with one leg over the arm of his chair, looking at the stars. He spun about when Arnie told him what Gev had said.

"Impossible!"

"Perhaps. But I believe him."

"Could it be a trick of his own? To get to the bridge?"

"I don't know. I doubt it. He is a man of honor—and I believe him.

"I hope that you are right—and that he is wrong. But I can't just ignore his charges. I'll get him up, but the master-at-arms will be standing behind him all the time." He turned to the phone.

General Gev came at once. The sergeant walked two paces behind him with his drawn automatic pistol in his hand. He held it at his waist, where it could not be grabbed, and he looked ready to use it.

"Could I see your passenger list?" Gev asked, then went through it carefully.

"This one and this one," he said, underscoring their names. "They have different aliases in the files, but they are the same men. One is wanted for sabotage, the other is suspected in a bombing plot. Very nasty types."

"It is hard to believe," Nils said. "They are the accredited representatives of these countries—"

"Who do exactly whatever Mother Russia asks them to. Please don't be naïve, Captain Hansen. A satellite means just that. Bought and paid for and ready to dance when someone else whistles the tune."

The telephone burred at Nils's elbow and he switched it on automatically.

A man's frightened face appeared on the screen, bright blood running down his face.

"Help!" he screamed.

Then there was a loud noise and the screen went blank.

XXIII

"What compartment was that?" Nils shouted, reaching for the dial on the phone. "Did anyone recognize that man?"

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Gev reached out and stopped him as he was about to dial: the sergeant raised his gun and centered it on Gev's back.

"Wait," Gev said. "Think. There is trouble, you know that much. That is enough for the moment. Alert your defenses first—if you have any. Then find out what area is threatened. I saw airtight doors throughout the ship. Can they be closed from here?"

"Yes—"

"Then close them. Slow down whatever is happening."

Nils hesitated an instant.

"It's a good idea, sir," the sergeant said.

Nils nodded. "Close all interior bulkhead doorways," he ordered.

The instrumentation officer threw back a protective plastic cover and flipped a row of switches.

"Those doors can be opened on the spot," the sergeant said.

"If you think this is an emergency, I can override the local controls," the instrumentation officer said.

"This is an emergency," Nils told him. "Do it."

Gev went to the wall by the door, out of their way. The sergeant lowered his gun.

"I did not mean to interfere with your command, Captain," Gev said. "It is just that I have a certain experience in these things."

"I'm glad that you're here," Nils told him. "We may have to use that experience." He dialed the engine room, and the call was answered at once by one of the technicians.

"A malfunction, sir. Exit doors are closed and can't be budged—"

"This is an emergency. There is trouble aboard, we don't know quite what yet. Stay away from the doors, no one gets in there—and let me know if you have any trouble."

"I think I recognized that man," the radio operator said, hesitantly. "A cook, or something to do with the kitchen."

"Good enough." Nils dialed the kitchen but the call was not completed. "That's where they are. But what the hell can they want with the kitchen?"

"Weapons, perhaps," Gev said. "Knives, cleavers, there will be plenty of them. Or perhaps something else— Could I see a plan of the ship."

Nils turned to Arnie. "Tell me quickly," he said. "Is this man on our side?"

Arnie nodded slowly. "I think he is now."

"All right. Sergeant, back to your post. Neergaard, get me the deck plans."

They unrolled them on the table and Gev stabbed down with his finger. "Here, what does *køkken* mean?"

"Kitchen."

"It makes sense. Look. It can be reached from the dining room, un-

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like any other part of the working section of this ship. Also—it shares an interior wall with the engine room. Which I assume is this one here."

Nils nodded.

"Then they won't try the doors. They'll cut their way in. Is there any way you can reach the engine room quickly? To reinforce the people there in case—"

The phone rang and the engineering officer came on the screen. "A torch of some kind, Captain, burning a hole through the wall. What should we do?"

"What did he say?" Gev asked, catching the man's worried tone but not understanding the Danish. Arnie quickly explained. Gev touched Nils's arm. "Tell them to get a bench or a table against the wall at this spot, pile anything heavy against it. Make entrance as difficult as possible."

Nils was looking haggard after issuing the orders. "They can't possibly stop them from breaking in."

"Reinforcements?"

There was no humor in Nils's smile. "We have only one gun aboard, the one worn by the sergeant—"

"If possible get him to the engine room. Unless you can counterattack through the kitchen. Strike hard, it is the only way."

"You would know," Nils said. "Get the sergeant in here. I'll have to ask him to volunteer. It's almost suicide."

The sergeant nodded when they told him what was happening.

"I'll be happy to undertake this, Captain. It could work if they are not heavily armed. I have another clip of bullets, but I won't take them. I doubt if there will be much chance to reload. I'll make these count. I can go in through that door from the aft storeroom. If it opens quietly enough, I could surprise them."

He carefully laid his cap aside and turned to General Gev, tapping the row of decorations on his chest. Instead of Danish he talked English now, with a thick cockney accent.

"I saw you looking at this, General. You're right, I was in Palestine, in the British Army, fighting the Hun. But when they started on your refugee ships afterwards, keeping them out, I went lost. Deserted. Back to Denmark. That wasn't my kind of thing."

"I believe you, Sergeant. Thank you for telling me."

The doors were unlocked in sequence so he could go through.

"He should be there by now," Nils said. "Call the engine room."

The technician was excited. "Captain—it sounded like shots! We could hear them through the wall, an awful lot of them. And the cutting has stopped."

"Good," Gev said, when he was told what had happened. "They may not have been stopped but they have been slowed down."

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"The sergeant has not come back," Nils said.

"He did not expect to." There was no expression at all on General Gev's face: emotion in battle was a luxury he could not afford. "Now a second counterattack must be launched. More men, volunteers if possible. Arm them with anything. We have a moment's respite and advantage must be taken of it. I will lead them if you will permit me—"

"The phone, Captain," the radio operator said. "It is one of the American delegation."

"I can't be bothered now."

"He says he knows about the attack and he wants to help."

Nils picked up the phone and the image of a man with thick-rimmed glasses, his face set in lines of gloom, looked out at him.

"I understand the Reds are attacking you, Captain Hansen. I can offer you some help. We are on the way to the bridge now—"

"Who are you? How do you know this?"

"My name is Baxter. I'm a security officer. I was sent on this voyage just in case something like this happened. I have some armed men with me, we're on our way now."

Nils did not need to see General Gev shake his head *no* to make up his mind.

"Did you say *armed* men? No arms were permitted aboard this ship."

"Armed for your defense, Captain. And you will need us now."

"I do not. Stay where you are. Someone will come to collect your weapons."

"We're leaving for the bridge now. Our country has stepped in before in a war, don't forget that. And NATO—"

"Damn NATO and damn you! If you make one move towards this bridge you are no different from those others."

"There have been quislings before, Captain Hansen," Baxter said, sternly. "Your government will appreciate what we are doing even if you don't." He broke the connection.

Gev was already running towards the exit to the passenger section of the ship. "It's locked," he shouted back. "Is there any way we can reinforce this door?"

The others, led by Nils, were close behind him. They were just in time to stare, aghast, at the television monitor. A group of men, five, ten, came into sight around the bend in the corridor outside, racing towards the door. Baxter was in front and behind him ran one of the Formosa delegates, some South Americans, a Vietnamese. One of them raised a broken-off chair leg and swung at the camera. It went blank.

"This is going to be difficult," Gev said calmly, looking at the door. "We are going to have to fight on two fronts—and we are not

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even equipped for combat on one."

"Captain," the radio operator called from the bridge. "Engine room reports that the cutting has started again."

There was a deep boom of an explosion, ear-hurting loud in the confined corridor, and the door bulged towards them, twisted, and a great cloud of smoke boiled in. They were stunned, knocked down. Then the door shivered and moved farther inwards, a man holding a makeshift gun began to squeeze through.

Gev sprang, hands out. Grabbing the man's wrist, twisting it so the gun pointed to the ceiling. It fired once, an almost soundless splat to their numbed ears. Then Gev chopped down with the edge of his free hand, breaking the man's neck. He fumbled an instant with the unusual mechanism of the gun, then poked it through the opening over the dead man's back and fired until it was empty.

This only delayed the attackers a moment. Then the door was pushed wider and two men climbed in, treading on the corpse. Nils hit one in the face with his fist, knocking him back through the opening with its force.

But they were outnumbered—and outgunned. Yet they gave a very good accounting of themselves. General Gev did not drop until he was hit with at least three bullets. They did not shoot Nils, but men hung from him, holding down his arms, while another clubbed him into submission. Arnie knew nothing about fighting, though he tried with very little success. Dead and wounded were left behind when they were dragged back to the bridge. The radio operator, the only crewman remaining there, was talking on the radio.

"Shut up!" Baxter shouted at him, raising his gun. "Who are you talking to?"

The operator, white-faced, clutched the microphone. "It is our Moon base. They have relayed the call to Copenhagen. I told them what was happening here. The others have broken into the engine room, taken it."

Baxter thought for a long moment, then lowered the gun, and he smiled. "You've done all right. Continue your report. Tell them that you have received assistance. The commies are not getting away with this. Now—how do I get in touch with the engine room?"

The radio operator pointed silently at the telephone screen where an impassive face looked out. Baxter was just as unemotional as he strode over to the phone.

"You're a traitor, Schmidt," he said. "I knew that as soon as I saw you were a member of the East German delegation. That was not very wise of you." Baxter turned to Nils who had been placed in a chair. He was struggling back to consciousness. "I know this man,

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Captain. A paid informer. It's a good thing for you that I am here."

General Gev slumped on the floor against the wall, listening silently, apparently unaware of his blood-soaked, dripping leg. His right arm had been hit by a bullet as well, and he had his hand pushed into the open front of his shirt. Arnie's glasses were broken, gone, and he blinked myopically, trying to understand what was happening.

Baxter looked distastefully at Schmidt's image. "I don't enjoy dealing with traitors—"

"We all have to make small sacrifices." Schmidt's words were heavy with irony. Baxter flushed with anger but went on, ignoring them.

"There seems to be a stalemate here. We hold the bridge and the controls."

"While I and my men are in charge of the engines and the drive unit. My forces are not as strong as they should be—but we are well armed. I think that you will find it impossible to defeat us. You will not get us out of here. So what do you intend to do, Mr. Baxter?"

"Is Dr. Nikitin with you?"

"Of course! Why else do you think we are here?"

Baxter broke the connection and turned to Nils. "This is very bad, Captain."

"What are you talking about?" The fog was clearing somewhat from Nils's battered head. "Who is this Nikitin?"

"One of their better physicists," Arnie said. "With the diagrams and circuitry he should know the basic principles of the Daleth drive by now."

"Exactly," Baxter said, and put his gun away. "They hold the engine room, but cannot take the bridge, so all is not lost. Report that to your superiors," he ordered the radio operator. "It is a stalemate for the moment—but if we had not been here they would have taken the entire ship. You see, Captain, you were mistaken about us."

"Where did you get the guns?" Nils asked. "That explosive?"

"Of what importance is that? Gun barrels looking like fountain pens, swallowed ammunition, plastic explosive in toothpaste tubes. The usual thing. It's not important."

"It is to me," Nils said, sitting up straighter. "And what do you propose to do now, Mr. Baxter?"

"Hard to say. Bandage you people up first. Try to arrange a deal with that double-agent Kraut. We'll work something out. Have to turn back I guess. Prevent any more killing. They know about the drive now, so the cat is out of the bag. No secrets left between allies, hey? Your people in Copenhagen will understand. I imagine America will handle it through NATO, but that's not my area of responsibility. I'm just the man in the field. But you can be sure of one thing," he

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drew himself up. "There is going to be no Daleth gap. The Russians are not going to get ahead of us with this one."

Nils rose slowly, painfully, and stumbled to his chair at the controls. "Who are you talking to?" he asked the radio operator.

"There is a patch to Copenhagen. One of the Minister's assistants. It is the middle of the night there and the others were asleep when I called. The King, the Prime Minister, they're on the way."

"I'm afraid we can't wait for them." They spoke English so Baxter could understand. Nils now turned to him. "I would like to explain what has happened."

"By all means, sure. They'll want to know."

Still in English, slowly and carefully, Nils outlined the recent occurrences. After a long delay, while the signal reached out to Earth and the answer came back, the man at the other end spoke in Danish, and Nils answered in the same language. When he had finished, there was a tense silence on the bridge.

"Well?" Baxter asked. "What was that about? What did they say?"

"They agreed with me," Nils told him. "The situation is hopeless."

"Good thinking."

"We agreed on what must be done. He thanked us."

"'He thanked us.' What the *hell* are you talking about?"

Nils was finished with patience and formality now. He spat the words with a slow anger that had finally burned through.

"I'm talking about stopping you, little man. Violence, death, killing, that is all you know. I don't see an ounce of difference between you and that swine now in charge of the engine room. In the name of good you do evil. For national pride you would destroy mankind. When will you admit that all men are brothers—and then find some way to stop killing your brothers? Your country alone has enough atomic bombs to blow up the world four times over. So why must you add the additional destruction of the Daleth effect?"

"The Russkies—"

"Are the same as you. From where I am, here in space, about to die, I can't tell the difference."

"Die?" Baxter was frightened, he raised his gun again.

"Yes. Did you think we would just hand you the Daleth drive? We tried to keep it away from you without killing, but you forced this on us. There are at least five tons of explosive distributed about the frame of this ship. Actuated by a radio signal from Earth—"

A series of rapid musical notes was sounding from the speaker and Baxter screamed hoarsely, turning, firing at the controls, hitting the radio operator, emptying his gun into the banks of instruments.

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"A radio signal that cannot be interrupted from here."

Nils turned to Arnie who was standing quietly. Nils took his hand and started to say something. General Gev was laughing, victoriously, enjoying this cosmic jest. The rightness appealed to him. Baxter shouted—

With a single great burst of flame everything ended.

XXIV

For Martha Hansen, events had a dreamlike quality that made them bearable. It had started when Ove had called at 4:17 in the morning, her clearest recollection of his call had been the position of the glowing hands in the dark while his voice buzzed in her ear.

4:17. The numbers must mean something important because they kept coming to the front of her mind. Was that the time her world had ended? No, she was still very much alive. But Nils was away on one of his flights. He had always returned from his flights before this—

That was the point where her thoughts would always slide around and come to something else. 4:17. The people who had called, talked to her, the Prime Minister himself. The Royal Family—4:17. She had tried to be nice to everyone. Surely she had. She had at least learned to be polite in finishing school, if she had not learned anything else.

But she should have noticed more about the trip to the Moon. But even then the numbness had prevailed. They had flown in one of the new Moon ships, spacebuses they were being called. Very much like flying in a jet, only with more room all around. A long cabin, rows of seats, sandwiches and drinks. Even a hostess. A tall, ash-blond girl who had seemed to stay quite close for most of the trip, had even talked to her a bit. With the kind of lilting Swedish accent the men loved. But sad now, like all of them. When had she seen a smile last?

The funeral ceremony had seemed empty. There was the monument all right, in the airless soil just beyond the windows. Draped in flags, a bugle had wailed a plaintive call that pulled at the heartstrings. But no one was buried there. No one would ever be buried there. An explosion, they had told her. Died instantly, painless. And so far away.

Days later Ove Rasmussen had told her the real story behind the explosion. It sounded like madness. People did not really do this kind of thing to each other. But they did. And Nils was the kind of man who could do what he had done. It wasn't suicide, she could not imagine Nils committing suicide. But a victory for what he knew was right. If he had to die at the same time she knew he would consider this second, and not give it

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much consideration at all. In dying he had taught her things about the man, living, that she had never realized.

"Just a drop of sherry?" Ulla asked, bending over her with a glass in her hand. They were in a lounge, the ceremony was over. They would be returning to Copenhagen soon.

"Yes, please. Thank you."

Martha sipped the drink and tried to pay attention to the others. She knew she had not been doing this of late, and also knew that they had been making allowances for it. She did not like that. It was too much like being pitied. She sipped again, and looked around. There was a high-ranking Army officer at the table with them, and someone, she forgot his name, from the Ministry of Space.

"It won't happen again," Ove said, angrily. "We treated the other countries as if they were civilized, not monsters of what?—national greed, that is the only term for it. Smuggled weapons, hired thugs, subversion, piracy in space. Almost unbelievable. They won't have a second chance. And we are not going to kill ourselves any more. We'll kill them if they ask for it."

"Hear, hear," the Army officer said.

"The new Daleth ships will be built with a complete internal division. We'll advertise the fact. Crew on one side, passengers on the other, without as much as a bulkhead in between. We'll have a troop of soldiers aboard if necessary. Armed with guns, gas—"

"Let's not get carried away, old boy."

"Yes, of course. But you know what I mean. It can't ever happen again."

"They won't stop trying," the man from the Ministry said, gloomily. "So they'll probably get the drive from us some day, if they don't stumble onto it themselves first."

"Fine," Ove said. "But we'll put that day off as long as possible. What else can we do?"

Silence was the only answer to this. What else *could* they do?

"Excuse me," Martha said, and the men rose as she left. She knew where to find the commanding officer of the base, and he was most accommodating.

"Of course, Mrs. Hansen," he told her. "There is no cause at all to refuse a request like this. We'll, of course, take care of sending Captain Hansen's effects back to you. But if there is anything you wish to take now—"

"No, it's not that so much. I just want to see where he lived when he was here. I hardly saw him at all this last year."

"Quite understandable. If you will permit me, I'll take you there myself."

It was a small room, not luxurious, in one of the first sections

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that had been built. She was left alone there. The walls, under their coats of paint, still showed the grain of the wooden mold the cement had been poured into. The bed was metal framed and hard, the wardrobe and built-in drawers functional. The only note of luxury was a window that faced out upon the lunar plain. It was a porthole, really, one of the first jury-rigs. Two standard ship's portholes that had been welded together to make a double-thick window.

She looked out at the airless reaches and the hills, sharp and clear beyond, and could imagine him standing here like this. His extra uniforms were hung neatly in the closet and she missed him, how she missed him! She still had tears left, not many, and she dabbed at her eyes with her handkerchief. It had been a mistake coming here, he was dead and gone and would never return to her. It was time to leave. As she turned to go she noticed the framed picture of her on the little desk. Small, in color, in a bathing suit, laughing during some happier time. For some reason she did not want to look at it. It was here because he had loved her, she knew that. She always should have known that. Despite everything.

Martha started to put the picture into her purse, but she did not really want it. She opened the top drawer of the dresser and poked it down under his pajamas. Her hand brushed something hard, and she pulled out a paperbound booklet. *"Elementær Vedligeholdelse og Drift af Daleth Maskinkomponenter af Model IV"* it was labeled, and as she mentally translated the compound, technical Danish terms, she flipped through the book. Diagrams, drawings and equations flicked past as the meaning of the title registered in her brain.

Basic Maintenance and Operation of Daleth Drive Units Mark-IV.

He must have been studying it; he always had to know all the details of the planes he flew. The new ships would be no different. He had stuffed it in here, forgotten it.

Men had died to obtain what she held in her hand. Other men had died to stop them.

She began to put it back into the drawer then hesitated, looking at it again.

Baxter was dead, she had been told about that, dead aboard the ship. There was a new man at the Embassy who had been trying to contact her, she had his name written down somewhere.

She could give this booklet to them and they would leave her alone. Everything would be settled once and for all and there would be no trouble.

Martha dropped the booklet into her purse and snapped it shut. It made no bulge at all. She slid the

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bureau drawer shut, looked around the room once more, then left.

When she rejoined the others some of them were already getting ready to leave. She glanced about the reception hall, seeking a familiar face. She found him, standing against the far wall, looking out of the large window.

"Herr Skou," she said, and he turned about sharply.

"Ahh, Mrs. Hansen. I saw you, but I have not had a chance to talk to you. Everything, everything—"

He had a haunted look on his face and she wondered if he, somehow, blamed himself for what had happened.

"Here," she said, opening her purse and handing him the booklet. "I found this with my husband's things. I didn't think that you wanted it lying around."

"Good God, no!" he said, when he saw the title. "Thank you, most kind, helpful. People never think. Doesn't help my work, I tell you. Numbered copy, we thought it was on board the *Holger Danske*. I never realized." He drew himself up and made a short, formal bow.

"Thank you, Fru Hansen. I don't think you realize how helpful you have been."

She smiled. "But I do know, Herr Skou. My husband and many others died to preserve what is in that book. Could I do less? And it is the other way around. Until now, I don't think I realized how helpful you, everyone, has been to me.'

And then it was time to return to Earth.

XXV

The brakes on the Sprite were locked hard as it turned into the driveway, the tires squealing as it slid to a bucking stop. Ove Rasmussen jumped over the car door without opening it and ran up the front steps to push hard on the doorbell. Even as the chimes were sounding over and over again inside he tried the handle. The door was unlocked and he threw it open.

"Martha—where are you?" he shouted. "Are you here?"

He closed the door and listened. There was only the ticking of a clock. Then he heard the muffled sobbing from the living room. She was sprawled on the couch, her shoulders shaking with the hopeless uncontrolled crying. The newspaper lay on the floor beside her.

"Ulla called me, I was at the lab all night," he said. "You sounded so bad on the phone that she was getting hysterical herself. I came at once. What happened—?"

Then he saw the front page of the newspaper and knew the answer. He bent and picked it up and looked at the photograph that almost filled the front page. It showed an egg-shaped vehicle about the size of a small car that

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was floating a few meters above a crowd of gaping people. A smiling girl waved from the little cockpit and on the front, between the headlights, the word *Honda* could plainly be seen. The craft had no obvious means of propulsion. The headline read JAPANESE REVEAL GRAVITY SCOOTER and underneath CLAIM NEW PRINCIPLE WILL REVOLUTIONIZE TRANSPORTATION.

Martha was sitting up now, dabbing at her eyes with a sodden handkerchief. Her face was red and puffy, her hair in a tangle.

"I had a sleeping pill," she said, almost choking on the words. "Twelve hours. I didn't hear the radio, anything. While I was getting my breakfast ready I brought in the paper. And there—" Her voice broke and she could only point.

Ove nodded wearily and dropped into the armchair.

"Is it true?" she asked. "The Japanese have the Daleth drive?"

He nodded again. Her fingers flew to her face, her nails sank into the flesh. She shrieked:

"Wasted! All killed for nothing! The Japs already knew about the Daleth effect, they stole it. Nils, all of them, they died for nothing!"

"Easy." Ove said and leaned forward to hold her shoulders, feeling her body shake as she cried in agony. "Tears can't bring him back, or any of the others."

"All that security . . . no good . . . the secret leaked out—"

"Security killed them all," Ove said, and his voice was as bleak as a winter midnight. "A stupid, stupid waste."

The bitterness of his words did what sympathy could not do; it reached Martha, shocked her. "What are you talking about?" she said, rubbing the tears from her eyes with the back of her hand.

"Just that." Ove looked at the newspaper with black hatred, then ground it with his foot. "We had no eternal secret, just a lead on the others. Arnie and I tried to tell security that but they would never listen. Apparently only Nils and his top officers knew about the destruction charges in the ship. If Arnie or I had known, we would have made a public stink and would have refused to fly in her. It is all a criminal waste, criminal stupidity."

"What does this mean?" She was frightened by his words.

"Just that. Only politicians and security agents believe in Secrets with a capital *S*. And maybe the people who read the spy novels about those imaginary stolen secrets. But mother nature has no secrets. Everything is right out where you can see it. Sometimes the answer is complex, or you have to know the right place to look before you find it. Arnie knew that, and that is one of the reasons he brought his discovery to Denmark. It could be developed faster here because we have the heavy indus-

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trial machinery to build the Daleth ships. But it was only a matter of time before everyone else caught up.

"Once they knew that there *was* a Daleth effect they would know just what they were looking for. We had two things in our favor. A number of physicists around the world knew that Arnie was doing gravity research. He corresponded with them and they read about his work in the journals. What they did not know was that his basic approach was wrong. He discovered that fact but never had time to publish the results. The real discovery of the Daleth effect came about through the telemetry records of the solar flare. These readouts were distributed to the cooperating countries and it was only a matter of time before the connection was tracked down. We had that time, almost two years of it, and it gave us the lead that we needed."

"Then the killings, the spies—"

"All waste. The secret of security is to never let the Right Hand know what the Left Hand is doing. A secret agency tries to steal the secret while other secret laboratories try to develop it. And once these agencies get rolling they are very hard to stop. It would be ironic if it were not so tragic. I have finally heard the entire story myself—I was up all night with the security people getting briefed on the whole story. Do you know how many countries already had a lead to the nature of the Daleth effect when the ship was blown up?

I'll tell you. *Five.* The Japanese thought they were first and tried to apply for international patents. There applications were turned down by four countries because earlier patent applications had been filed in these countries and held under government security. Germany and India were two of these countries."

"And the other two?" She gasped the words as though she already knew.

"America and the Soviet Union—"

"NO!"

"I'm sorry. It hurts me as much to say it as it does for you to hear it. Your husband, Arnie, my friends and colleague died in that explosion. Wasted. *Because the countries that caused it already knew the answer.* But since the information was top secret they could not tell other agencies or men in the field. But I no more hold them to blame than I do our own security who wired the explosives into the ship in the first place. Nor do I blame any other country involved in the mess. It is just institutionalized paranoia. All security men are the same, drawn to the work by their own insecurities and fears. They may be sincere patriots, but their sickness is what makes them demonstrate their patriotism in this

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manner. This kind of person will never understand that when it is steamboat time you build steamboats, airplane time you build airplanes."

"I don't understand you." She wanted to cry now but she could not; she was beyond tears.

"The story always repeats itself. As soon as the Japanese even *heard* about American radar during World War II they went to work on it. They developed the magnetron and other vital parts almost as soon as the Americans did. Only internal squabbling and the lack of production facilities kept them from making it operational. It was radar time. And now . . . now it is Daleth time."

Then there was a long silence. A cloud passed over the sun outside and the room darkened. Finally Martha spoke: she had to ask the question.

"Was it all a waste? Their deaths. A complete waste?"

"No." Ove hesitated and tried to smile, but he could not do it. "At least I hope that it is not a complete waste. Men from a lot of countries died in that explosion. The shock of this could drive some sense into peoples' heads, and maybe even into politicians' heads. They might use this discovery for the mutual good of all mankind. Do the right thing just this once. Without bickering. Without turning it into one more fantastically destructive weapon. Used correctly the Daleth effect could make the world a paradise. The Japanese even went us one better—they've eliminated the separate power source. They looked into the energy conservation and found out that they could use the Daleth effect to power itself. So we now all live in the suburbs of the same world city. That fact will take some getting used to. But the world, all of us, must get together and face that fact. Any person or country who tries to use this power for harm or for war will have to be stopped—instantly—for the greater good of all.

"Look at it that way and the deaths are not a waste. If we can learn something from their sacrifice, it might all have been worthwhile."

"Can we?" Martha asked. "Can we really? Make the kind of world we all say that we want but never seem able to attain?"

"We are going to have to," he said, leaning forward and taking her hands. "Or we will certainly die trying."

She laughed. Without humor.

"One world or none. I seem to have heard that before."

The cloud passed and the sun came out again but inside the house, in the room where the two people sat, there was a darkness that would not lift. ■

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THE BIGGEST OIL DISASTER

Part of the problem of Environment is that a major factor in that is human—and it doesn't follow simple, rational laws, but complex forces called Fear and Panic . . .

HAYDEN HOWARD

Illustrated by Leo Summers

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More than a hundred of those so-called human beings have been identified from news photographs taken during the fire. I consider all murdered him.

I shouldn't feel guilty. I don't know what he yelled at them. There was something about him which made people mad. Even if I'd been able to really communicate with him, it was too late for him to change. We couldn't even agree on the difference between science and technology. He said there wasn't any difference.

There was increasing awkwardness between us. It was my first real job, but I didn't want to feel involved. I tried to act as if we were strangers.

My first day in our Manhattan office, I startled him by addressing him as Mr. Sirbuh. That made him blink and grin. He looked terribly old and self-conscious. His weathered face seemed out of place above a plastic free-form desk.

But I'd always had to admire him for the way he'd overcome some of his educational handicaps. He was gray-haired by the time he organized The Sirbuh Oil Exploration Company. Now his hair had turned white. But he'd always said there were more goodies to be found under the ocean than on Mars.

His thick-knuckled hand turned off a radio commentator's accusations. He tried to grin. "I phoned early and told Joe that I won't be their fall guy. It's in Federal waters. He's Secretary, so he's stuck with the biggest decision he'll ever make."

He glanced down at his battered old diver's watch. "I told him the Interior Department has got to approve my proposal this time. Nothing wrong if it also blasts an oil storage cavity for me . . . us."

He grinned at me. "I don't know why Joe's so panicky. The Defense Department shoots off bigger ones under Nevada all the time. I'm drilling the relief hole. All we need is his authorization now. It's only a thirty kiloton device. It's the only way to shut off their leaking fissure."

He leaned over his desk. "To put the heat under him, I've scheduled a news conference for this afternoon. That's after we come back from our drill ship. So be thinking what you're going to tell the protesters at their airfield."

I had difficulty rising. When our transonic exec jet, rented for the day, swooped over the coastal town, people swarmed on to the runway. They were waving the same old cardboard signs. SAVE OUR BEACHES. STOP ALL DRILLING. They were still trying.

But they didn't stop us. We taxied so close to our copter that we were able to outrun them to its open door. Triumphantly, Mr. Sirbuh shouted back at them: "News conference isn't until four."

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As we lifted, I looked down at their faces. They were understandably disturbed about the new oil slick approaching their beach. What worried me was that by this afternoon they would be hearing rumors about our proposal to explode a nuclear device out there. I didn't know how disturbed they could get.

Our copter, rented by the month, chattered out over the ocean. I blinked at the colorfully iridescent fringe of the oil slick and realized it was odd how little I knew about the technical side of the industry. I deliberately hadn't listened when I was a kid. In those days, I couldn't bear to listen because I feared that he might be "going broke."

Beyond the undulating water of the Sanctuary swayed the steeplemast of our drill ship. I knew leasing it was costing us $10,000 a day. It was positioned above our production satellite, which had been designed by Mr. Sirbuh and constructed on credit. Our interest payments were sheer agony to me. Because the water was so deep, everything took longer than planned. We were going broke.

The ocean seemed to be boiling about a mile this side of our drill ship. So much gas was erupting from the fissure at the bottom that the surface appeared hump-backed. It was hazy with fumes. The leak was in Federal water. It was in the Sanctuary where no drilling was permitted.

The tract we had leased from the government adjoined it. Around our drill ship the water was clear.

"How can they say it's our fault?" I shouted through the copter's noise at his nearer ear.

Like a lot of former hard-hat divers, he was slightly deaf, but he heard that, and his teeth flashed.

"The old Blame Game," he shouted back. "Let our lawyer worry about that." He grinned as if in pain. "I won't go looking for a share of the blame. I've got to fight to save our corporation. But —to hell with who's to blame for what!" He pointed back toward shore. "Washington don't seem to realize how bad this leak is. It's the biggest gusher in . . . it could go on for years."

I felt another childhood shiver of fear and imagined battalions of government lawyers trying to blame us, frame us. The people along the coast would be suing everybody for billions in damages. I was afraid he couldn't protect himself. All my life I'd never really had faith in him. "We never should have leased this tract—"

"O.K., Mr. Know-It-All." He laughed like that when he was grief-stricken. He also laughed like that when he was fighting mad. "You've never made a big decision in your life, so start passing judgment, Mr. Accounting Student! That's what you were supposed to be studying, wasn't it, besides girls?

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Mr. Gentleman's 'C'. Lately, you've been acting like Mr. Scientific Expert, too. So preach. Pass judgment on everybody. But be careful. I think you've been a . . . what's the word? . . . hypocrite since age ten."

I stared out the window. When he said things like that, what could I feel toward him?

As the copter banked, I saw the emergency barge provided by the industry was near a much smaller boil, a square of bubbles. Evidently their hood to capture leaking oil had been lowered over that part of the fissure. And this bigger boil had burst out farther along the fissure last night.

Our copter tilted sickeningly, and he seemed to nod. A dark carpet of oil was spreading downwind from the bigger boil. Two little boats circled in it like a pair of water beetles. They were spraying out a coagulating agent and vacuuming in the thickened oil. They looked so small. The water was two thousand feet deep.

"This gas won't last forever," Mr. Sirbuh shouted. "Lot more oil will start coming up. Interior Department better take my advice."

Our copter clumped on the landing deck. As I followed him along a catwalk toward the drilling deck I felt the ship gently swaying. I'd helped write our latest stock market brochure, so I visualized the hydrophones under its hull. They were aimed down at the sound beacon on the satellite. In theory, every movement of our ship would be noticed and corrected by the computer, which gave orders to the propellers. This ship stayed in one place.

There was a thrashing sound, and I peered over the side. It was odd to see a propeller on the side of a hull. It whirled, stopped, whirled again. In our brochure this was called dynamic positioning. Propellers around the hull maintained the ship's position above our satellite. Down there it tended the wellheads.

On the drilling deck, standing under the rig, two middle-aged men wearing business suits, but crowned by tin hats, were glaring at Mr. Sirbuh. They were minor Federal officials. The chubby one pointed toward the big boil and began orating. He wanted to move our ship closer.

"Use your brains," Mr. Sirbuh shouted back, and he nodded to our drilling console, where a new graph strip was emerging like a paper tongue. "I'm saving time by starting the relief hole from here."

To their disbelief he retorted: "Water this deep, my satellite has to guide the drilling. Would take a week to uproot it and move it nearer." He looked toward the big boil. "From here is a longer hole but quicker. I know what I'm doing."

"That's what I'm afraid of," the

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fat official shrilled. "To what depth you slant-drilling this hole at the fissure?"

"Right under a shale formation," Mr. Sirbuh replied with an innocent smile. "The lower caprock. About eighteen hundred feet down."

The official exclaimed: "That's the same depth as your proposal last year, same depth as that storage cavity you wanted to blast."

Last year our proposal to use instant nuclear energy to create an oil storage cavity had been rejected by their department.

Mr. Sirbuh shrugged. "It also happens to be the best depth for blasting the caprock against your fissure. To clog it and—"

"You don't know what that blast would do. Start new leaks." The official glared, but Mr. Sirbuh stared him down.

"It ought to interfere with your big boil," Mr. Sirbuh said, "about eighteen hundred feet underground. Around the blast cavity, the formations will have been squeezed. Their leaks will have been obstructed. Gas and oil will begin to bleed into the cavity, but slowly at first. This will give us time to grout the surface fissures with cement. It will give us time to drill vertical holes. We'll begin withdrawing the gas and oil that are being captured in the cavity." He laughed. "That way we'll prevent the boil from bursting again."

Mr. Sirbuh spread his arms at the beauty of his proposal. "I plan to lease a riserless drill ship which can start large diameter holes straight down into the cavity. The trapped gas and oil will rise through the paths of least resistance, our pipes. The captured oil will be spouting up through our hoses into a supertanker and then another supertanker. Your gusher will be controlled. Now we need to be issued a nuclear device which can be slid down this hole."

"You've been ordered to pump down cement."

"But we both know the gusher's so powerful," Mr. Sirbuh snorted, "that it will spit up cement. Your boss better hurry and authorize our nuc device to stop your leak."

"Our leak?" the fat man hissed venomously. "But the gas is coming from your tract."

"Let's let the courts decide," Mr. Sirbuh retorted.

"So we're trying to find out." The thinner official was holding the endless folds of a graph strip draped over his forearm. "We want to—see what really happened in your #3 hole. We think it started the blowout into the fissure."

"I don't," Mr. Sirbuh replied mildly.

He'd intended #3 to be our third producer from the shallow sands. But our oil storage dilemma had caught up with us. After our original proposal to use instant nuclear energy to excavate an under-

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ground storage cavity had been denied by the Interior Department, our alternative didn't work out. The submersible storage tank cost nearly twice Mr. Sirbuh's original estimate.

Ironically, our first two wells were great producers. The sunken tank was too small for a variety of reasons. We needed another. But our other deepwater production expenses were so high that even a larger capacity tank wouldn't be economically feasible. We needed much larger and cheaper storage in order to get cheaper transport.

None of the major oil companies had bid on our tract, apparently because it was so isolated. Their shallow-water platforms pumped through a cooperative pipeline to shore. But we were too distant from them. Even if we had been able to afford it, the Interior Department wouldn't let us lay our own pipleine across the Sanctuary. They'd argued it might leak or break sometime in the far future, spilling oil. They talked about pollution.

We were barging oil to shore storage tanks. Operating costs were too high. Even if we had enough storage capacity out here to fill a little coastal tanker, we wouldn't be competitive with the major oil companies. What we needed was cheaper storage with such enormous capacity we could fill an oceanic-sized tanker.

But all we had was one little sunken storage tank and the threat of bankruptcy. So Mr. Sirbuh had wildcatted #3 below our producing field. He hoped to discover another pool so impressive we could sell more stock. We needed more cash to keep operating.

Streamers of the graph paper rippled in the wind. While the two officials studied this drilling record of our #3 hole, they argued with Mr. Sirbuh. Below our shallow oil sands, the bit had chewed through a slanting shale formation. This turned out to be caprock for a deeper pool.

Our wildcat had struck gas. The lubricating mud in the drill pipe was kicked upward. The gas pressure down there was so tremendous that it lifted the weight of the two-mile tall column of drilling mud. From our riser-pipe, mud and its burden of rock chips geysered over the crew.

They activated the blowout preventer at the wellhead. This closure was controlled through the satellite on the ocean floor. The mud in the hole was recirculated through the satellite, removing gas bubbles. This would help regain the restraining weight of that mud. And the remaining mud in the riser, the umbilical to the satellite, was recirculated into the ship. Barite was added, increasing its weight. They held down the gas. The graph showed everything was under control again.

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By telephone from New York, Mr. Sirbuh had told them to keep drilling.

The next morning a helicopter pilot had reported gas bubbling up in the Federal Sanctuary about a mile from our ship.

Now Mr. Sirbuh argued there was no evidence of a connection. "The bottom of my #3 hole is a half mile from your Sanctuary."

"But your shale strata slope up into it," the fat official shrilled. "Our fault provides the dam for your oil pool."

I didn't know much about oil geology. But I visualized layers of shale slanting up like shed roofs. The gas and oil were underneath and rose along the undersides of the roofs until something stopped them like a wall. The opposite face of the fault might be an impermeable formation. But if the sloping roof of caprock didn't fit tightly against this wall, the gas and oil could escape upward through the fissure.

"It's not in my tract," Mr. Sirbuh was repeating. "When you ordered us to pump cement down #3, we pumped a helluva lot and there was no effect on your leak." He grinned. "Your gas pressure has been trying to get out for millions of years. Now it has, and the courts should classify it as an Act-of-God. I've been advising your boss in Washington that the only way to shut it off is nuclear—"

"But he's ordered you," the thin official interrupted, "to be ready to pump bargeloads of that new sealant down this relief hole."

We glanced up as the next string of drill pipe was lowered into the riser. I knew he was talking about that terribly expensive slower-coagulating cement which was supposed to penetrate a formation and then seal it.

"A few thousand barrels of cement?" Mr. Sirbuh laughed. "For this big boil? That's like trying to constipate an elephant with a hypo of distilled water. Let's face the truth. This is a bigger gusher than Old Maude. Maybe even more oil than another Lakeview #1. It's bigger than another Spindletop. But you're trying to tell me the fissure can be closed with a little cement?"

He spread his arms. "Your fault is miles long. If you merely hold the gas down here, she'll pop up ten other places. The only chance to shut her off is down nearer the source—with a bang!"

"It's never been done," the thin official shouted.

"They also said I couldn't bring in a successful field in water this deep," Mr. Sirbuh laughed. "You're all scared because of politics. Instead of thinking about what needs to be done, you're worrying about a few loud-mouth voters in the coastal towns. A few old ladies—"

His hand closed on my shoulder. "They'll never even feel it. Maybe

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one little jiggle like at Las Vegas, and the oil will stop."

He grimaced at me. "You've got to explain this to the news media and those people. When they get mad enough, maybe that will force Washington to make a decision. Things can't go on like they are."

He walked me toward the elevator framework. "After this gas, so much oil will come up that their whole coast will be black with it for years. It'll leak for years. Our nuclear proposal is the only chance of heading off that real disaster."

He steered me into the skeletal elevator. "You tell the newsmen how bad things are on the bottom. The Secretary's got to hurry up and decide."

He pressed the button. Our elevator slid. Below us, lolling in its collar-dock like a yellow porpoise was the minisub.

"I wouldn't know what I was seeing down there," I protested.

"Since yesterday you've been in charge of public relations." His grip tightened on me.

Yesterday our public relations counselor had thrown up his hands and quit. Mr. Sirbuh had hired him a year ago to smooth things over after our original proposal to excavate an oil storage cavity had been denied. Half the people in the coastal towns had been afraid of vented radiation. The other half were hysterical that we might trigger earthquakes. We had received a bad image all the way to Washington.

As we stepped out of the skeletal elevator, Mr. Sirbuh yelled: "Sam, you ready to take us down?"

A white-haired head protruded from the hatch. The old ex-diver stared up blankly at Mr. Sirbuh.

"I said—you fixed the sub's wiring?" Mr. Sirhub shouted.

"Yeah. Lights blink. Shorts." He was deafer than Mr. Sirbuh. "But she'll dive."

"I told the press we'd have a report for them by four o'clock." Mr. Sirbuh pushed me ahead of him. "Back at their airport we'll tell them the truth," he was saying to me. "The leak is on government property. It's not our responsibility. But we're doing everything we can to help shut it off."

As I lowered myself through the hatch, he shouted: "Be able to describe how safe and advanced our deepwater drilling equipment is. Even if you can't see much, describe how uncontrollably huge their gusher is—"

The hatch-cover clanged above my face. I'd thought he was coming with us. But he was already tightening the bolts up there. There was a rasping sound.

"Put this on." The old diver's rough voice reminded me of Mr. Sirbuh's.

The padded helmet made me feel as if I were in a Moon-hopper. On the choppy surface, in the bobbing little submarine, I hung on.

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Then everything slowed, steadied, dimmed, and I knew we'd sunk.

"Crawl forward," the old pilot croaked.

Its blunt nose was like glass. Its articulated arms out there, with which it tended the satellite, made me think of the stainless steel manipulator claws in atomic labs. I discovered a control grip for my right hand, another for my left.

"Don't touch 'em," his voice croaked.

I lifted my head. The dark mass above us was the bottom of the drill ship.

Down past us hung the riser. I knew this vulnerable tube was more than two thousand feet long. It served at least two purposes. Lengths of drilling pipe descended through it to the wellhead and hole, where the satellite presided. Mud was circulated down through the drilling pipe, lubricating the bit, and up again between the drilling pipe and the inner surface of the riser. This carried up rock debris, which was strained out in the ship, while the distant bit chewed deeper.

The weight of the mud in the riser and the treacherous currents from the sea continually threatened to break that slightly flexible tube. I knew some companies were using riserless methods of drilling in deep water. But Mr. Sirbuh's was a traditional riser design, with improved metallurgy due to space-research spin-offs. Its metal-ceramic laminated construction provided an improved strength-to-weight ratio, which was doing the job, he'd kept repeating triumphantly.

I supposed I should admire technological improvements. But our minisub seemed to be sinking like a stone. My ears hurt although the sub was supposed to maintain a shirtsleeve environment. In the engulfing dampness of my sweat, I tried to meditate calmly on the technology of deep-water drilling. I didn't think it qualified as a science. I wasn't sure how to define science, but this wasn't it.

There was so much haphazard development. And workmen kept getting squashed by falling pipes, or drowned. I winced at that thought. There was a matter of attitude. Our drilling decisions were hurried by financial pressures.

In crushing blindness we hit bottom. I opened my eyes and was bathed in glorious light. The pilot laughed with pride. By a sonic signal, he'd turned on floodlights mounted atop our production satellite so that it illuminated its own silvery strangeness.

It was so new that the cancerously creeping sea life hadn't shrouded it yet. It gleamed above us in the blackness like a deep-space vehicle. From our stock sales brochure, I remembered that the littlest sphere on top provided pressure-mating for our minisub. This way an electronics repairman could enter the automated system.

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The middle sphere was larger. It contained the remote cameras and control equipment. While I watched, an external slave-arm reached outward. Its claw turned a knob on one *christmas tree* of pipes and valves. Both of our producing wellheads were topped by this elaborate plumbing.

Pipes led into the big bottom sphere. It separated the gas and sand from the oil. Like a globular cow, it stood in the ring of thirty pipe-stumps. These were guides for drilling our wells. In addition to the two stumps with *christmas trees,* a third stump had an oddly bulbous blowout preventer on its wellhead. I supposed it was hole #3, the wildcat, the troublemaker. It had been disconnected. Our long riser now sagged almost diagonally into a fourth stump, which was tilted in the direction of the Sanctuary, aimed at the depths of the fissure.

"Look at that shallow slant," the pilot's voice croaked. "This relief hole's the craziest we ever tried."

Above us, the riser seemed to squirm in the currents. I imagined its drill pipe worming through the Earth toward the fault and Mr. Sirbuh standing on the drill ship, glaring expectantly toward Washington.

I went blind. The pilot had switched off the satellite's floodlights. Then our tiny lights came on. Like two pale fingers, our headlight beams slid across the bottom ooze. They brushed against the apparent immensity of our submerged storage tank. To me, it resembled a capsized ship. But it was too small to serve all thirty future wells or even three or four wells economically. I noticed its buoyed hose which connected it with the surface. I wished I were up there.

"Show you the damn fissure. Cause of all the trouble," the old diver's voice rasped as if the fissure were to blame.

Our headlights groping, we glided above endless ooze. It seemed devoid of life. The inward soaking cold clasped me through my wet shirt, and I hoped the pilot knew what he was doing. I hoped Mr. Sirbuh knew what he was doing this time.

We began crossing outcroppings of shale like whales' backbones, all leaning away from us. They were the protruding ends of strata. I knew that these same strata lay deep in the Earth beneath our satellite and curved up here. They tipped away from us, row on row.

Abruptly there was nothing ahead of us except level sand. I realized we had reached a geological discontinuity. The minisub banked through three dimensions like a slow-motion spacecraft and cruised parallel to the last ridge of shale.

"Their fault," the old man muttered, and I knew he meant that

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it was inside their Sanctuary. I hoped it was.

I'd expected something more spectacular. But its gaping fissure, if any, appeared to be filled with sand. At my right continued those tilted tiers of shale. At my left the bottom was deathly flat. This contrast, this fault, this earthquake interface was where the Earth had moved and would move again.

Ahead of us in the sand below the last shale outcropping lay a soft-lipped trench. A few bubbles flashed upward through our headlight beams.

"Blew out here first," he croaked. "Next day the gas pressure found a weaker spot. Shifted farther along the fault. Each day more oil. Hope we're out of our tract."

"At the edge of the pit, in the sand, what's that stuff?" I asked, merely curious. "Lumped with the sand. Doesn't look like oil."

"Don't see nothing," he wheezed and steered the sub along the sand-filled fissure.

"Could all that tremendous gas pressure," I asked, "have spit up drilling mud—or that new cement —all the way from our #3 hole?"

"Didn't see no mud. So forget it. Look ahead." He wasn't as deaf as he made out. "I hear gas bubbling around the hood."

Astride the fissure, the emergency hood appeared as big as a five-story apartment building fabricated from rusty steel. Its roof was sharply peaked. From its chimney-pipe, a thick hose pythoned toward the surface, carrying captured gas and oil to the emergency barge.

"Yesterday, when I was down, lot more gas here," he shouted. "So much, I thought their hood would lift. Tip over. Today most of the gas has shifted to the big boil. Really big. Hang on."

Ahead, the water was murkier. The minisub bucked. Noise cascaded against us as if we were entering Niagra Falls, falling upward. Gusts of bubbles flashed from the invisible gusher. Clouds of sand engulfed my vision. Our sub's nose was hurled up. As I hung on, I glimpsed streamers of darkness in front of our wildly waving headlights.

"Lot more oil today," he yelled.

My helmet thudded against the glass. In the swirling liquid haze of sand, I felt as if our minisub was being whirled end for end.

"Not engineered for this," he was shouting. "You've seen enough."

I thought I'd seen too much. Instead of feeling frightened, I felt emptied, as if I had nothing more to lose. The worst had already happened, I realized, when I'd seen that little trench back at that first gas blowout. In its closed lips of sand, those lumps must have been the new cement. Gas pressure had forced it up a slanting channel under the caprock, all the way from Mr. Sirbuh's distant #3 hole, the

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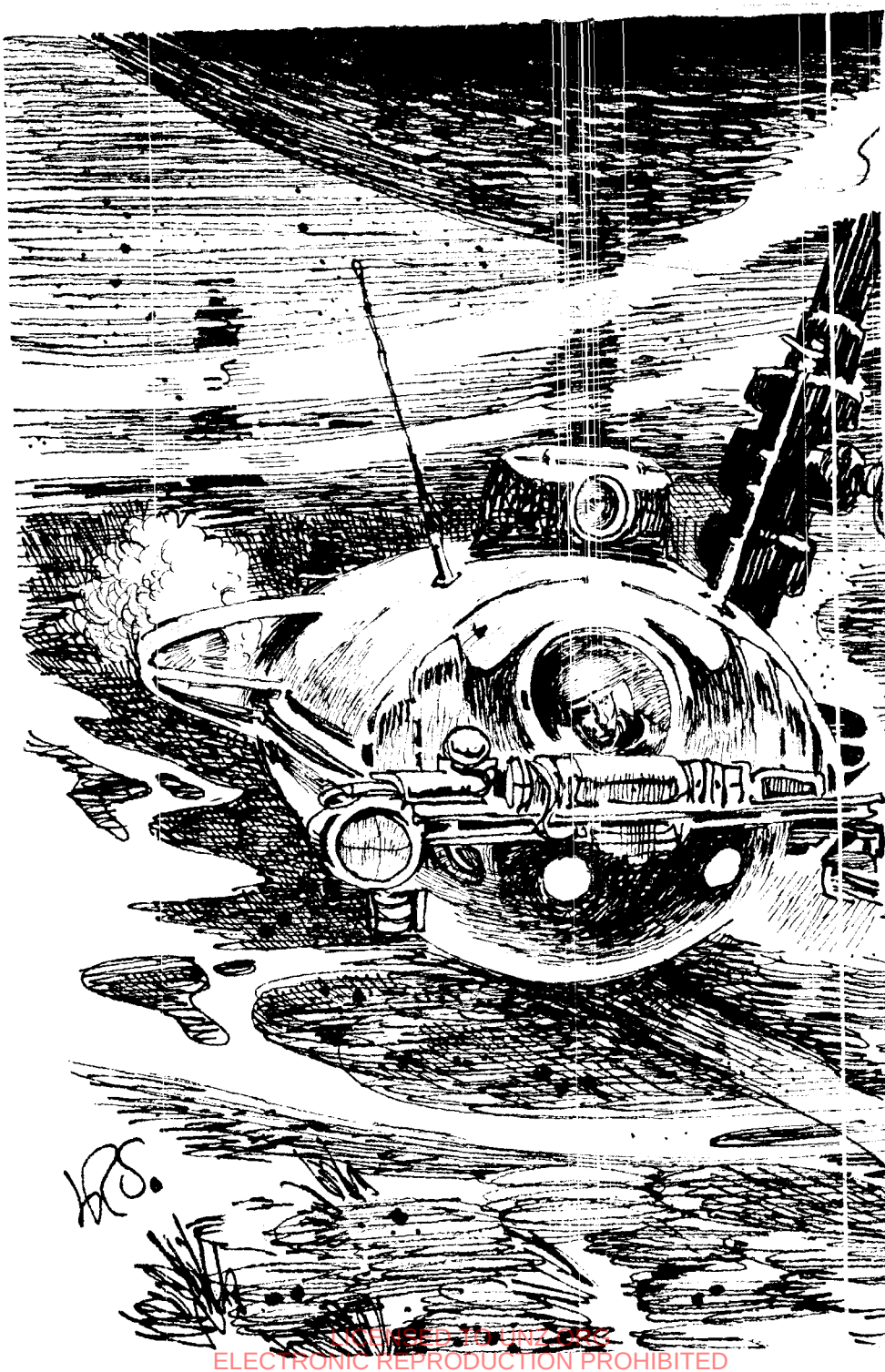

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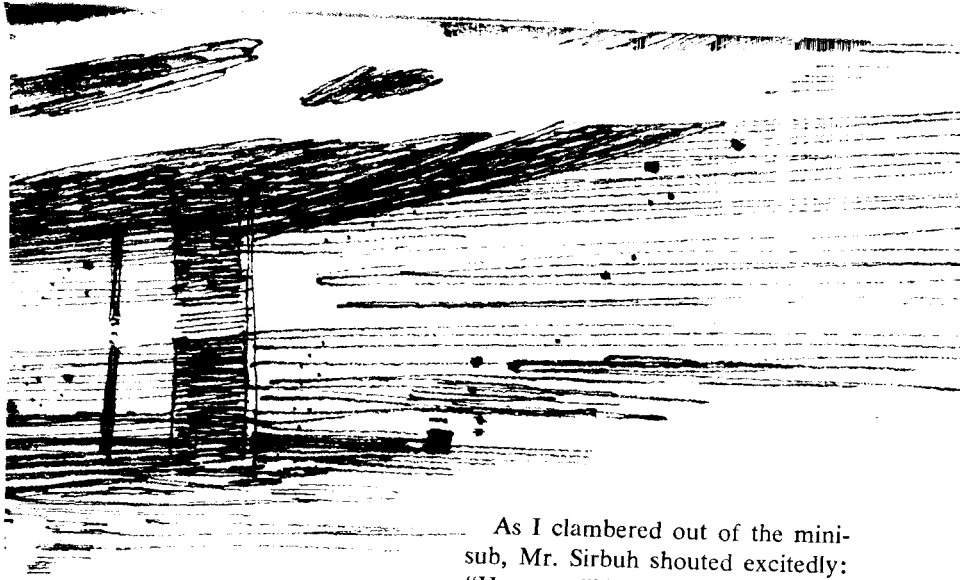
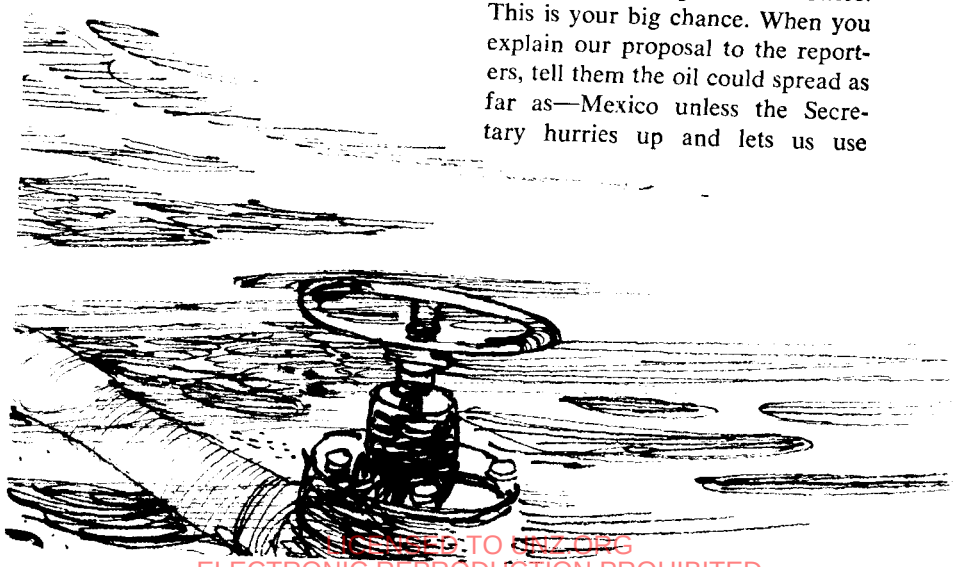


wildcat. It had spat up cement here, evidence of a geological connection and our responsibility.

As our minisub zepplined upward, I wanted to consider it an Act-of-God. The undersurface of the water glared above me like a mirror. My last boyhood illusions were being distorted, and I didn't know what to say when we reached the surface.

As I clambered out of the minisub, Mr. Sirbuh shouted excitedly: "Hurry up!" He was grinning. "I've got Joe cornered. I just heard it over the radio. Interior Department hasn't officially admitted receiving my proposal. But the news commentators know all about it. They're already second-guessing the Secretary. The pressure's on Joe to decide."

He laughed and hugged me. "We've got to hurry back to their airfield for the press conference. This is your big chance. When you explain our proposal to the reporters, tell them the oil could spread as far as—Mexico unless the Secretary hurries up and lets us use



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the nuclear-powered safety device. That's what it is—"

The old minisub pilot overtook him beside the elevator. "Before you go—" He steered Mr. Sirbuh away. "Tip you off—"

"No use confusing the issue," Mr. Sirbuh was replying as he strode back to the elevator. "The important thing is to stop the leak quick." He pressed the button and the elevator left my stomach behind and the old diver gaping upward after us.

Mr. Sirbuh herded me along the catwalk to the copter platform.

"Joe's the one who's cornered," he repeated. "As Secretary, he's got to decide. Either way, he'll lose his popularity and the government will be liable for damage suits. We won't be—"

"Down there," I blurted over my shoulder at him. "Looked like cement. It's in the sand. From a fissure—" But his strong hand maneuvered me into the copter as easily as if I were still a little boy.

"Not very likely," he laughed. "Forget it. Describe to the newsmen how safe our equipment is. Our drilling procedures have been safer than the government regulations require. Because of our scientific expertise we'll do everything we can to help the government stop its leak."

"Scientific?" I yelled. "Like what?"

The expression on my face seemed to startle him, and he shouted through the starting whine of the copter's engine: "What's wrong with you?"

I couldn't answer.

"See," he shouted as if I were stupid, and he tilted his right forearm upward. "These shale formations slope up like this against the fault." He pressed his fingertips against his vertical left hand. "Not a tight enough fit, so gas escapes into the water."

But I imagined the high-pressure gas pocket deep under his right elbow, where the eruption had begun when #3 hole was drilled through. On the drill ship they'd controlled the gas which was trying to go up the pipe. The mud held it down, later, cement. But gas must have forced its way up the outside of the casing, between the pipe-casing and enclosing hole, eroding a larger and larger escape channel. When it reached a natural weakness under the caprock, it had veered diagonally upward, away from the hole, toward the Sanctuary.

When it reached his left hand, the fault, the vertical fissure, it had roared straight up. It even spat up a little cement all the way from the bottom opening of our #3 hole more than a half mile away. Our gas and oil had erupted through two thousand feet of water.

The ocean was darkly gleaming beneath our copter.

"See," he was shouting. "Simply need Secretary's approval . . . blast

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. . . smash shale against the fault."

"Or open it wider?" I yelled. "And vent radiation into the ocean?"

"Not likely." He grinned as if in pain. "You've never . . . I don't know why you've never had faith in me. The blast should clog the leak. The cavity should trap most of the radiation. Any vented radiation would be minimal. Its effect on the environment—your favorite word—should be zero, or minor, and temporary, inconsequential. Studies indicate this—"

"But those people at the airfield will be frantic," I shouted. "Last year, when you proposed blasting that oil storage cavity, the town sent a delegation to Washington. They're afraid of radiation and earthquakes."

"This time they haven't much choice. The oil could flow forever. This will be one little bang," he shouted. "It's how we learn, by trying. The experts—"

"These beach-town people don't trust anybody. For ten years—"

"Those other oil spills weren't ours. We've never," he said, "had an oil spill. Those were other oil companies—"

"But if we could practice," I yelled, "like in some isolated deep lake, where oil or radiation wouldn't spread."

"Not practical," he laughed unhappily. "Formations wouldn't be the same. Listen, I've spent too much money on seismic surveys and then my geologists usually guessed wrong. In this business, you've got to drill and hope."

"But we'd be responsible."

"The government is responsible. They leased out these oil tracts for drilling. We just do the best we can."

"I'm supposed to reassure the people with that?" I protested.

"It's only a thirty kiloton device. I'd tell 'em myself," he laughed and shrugged. "But everything I say makes somebody mad."

"By now those people at the airfield will have heard rumors, what you've proposed. They're probably hysterical."

"They won't even feel the blast." The sun blazed against his face as he grinned down at the world. He began shouting with exhilaration. "I know I'm right. It's the only way. After it's exploded on our side of the tract line, we'll have a storage cavity for a lot more than thirty wells. It can hold the leaking oil and stop this mess."

He pointed downward. "It's been calculated that most of the radiation will be trapped in the melted rock at the bottom of the cavity. But there'll also be a pile of contaminated rubble in there. If we'd had time and luck, and if only a little oil had been leaking into it from surrounding formations, we could have drilled two holes and flushed seawater through the cavity. We'd clean it out so slowly that any radiation carried into the ocean would

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be less than the permissible limits. Then our satellite could have pumped in oil from its wells. But now the gusher will be filling the cavity, and our first cargo of captured oil may be somewhat radioactive."

He grabbed my shoulder. "It was a beautiful plan. No additional pumping costs from the cavity. Oil rises to the top. The pressure of two thousand feet of water helps it gusher up through the hoses into the tankers, when they come. Big tankers, big enough to make our whole production operation economically competitive with the major oil companies. It could still happen."

He laughed. "There goes my big mouth again. Lucky for me that you're here to talk to the newsmen at the airfield. You know what *not* to say. Simply explain to the people how we can stop their leak. That's the main thing."

Our copter tilted downward, and he shouted: "You handle the newsmen, and tonight when we get back to New York—I'll handle our stockholders. With this deeper oil strike and our storage problem about to be solved, I hope, they'd better stay with us. Courage is—"

Below our copter, the crowd spread out on the runway. I saw they'd surrounded the little exec jet which was waiting to take us back to New York.

"Ten times as many people as this morning," I bleated.

"I wouldn't ask you to talk to them but—" He grinned.

Before our public relations counselor quit, he'd advised Mr. Sirbuh to avoid any more interviews like last year's. Newsmen had asked Mr. Sirbuh unfair questions. While he was trying to explain his original oil storage cavity proposal, he'd lost his temper. He'd accused them of being against all progress. His remarks became unprintable. I knew he'd been suffering another of his blinding headaches. But the newsmen had gleefully characterized him as an irresponsibly hard-drinking former hard-hat diver who had turned big-mouth oil promoter and wasn't concerned about the people in the coastal towns.

"Look at them scatter," he shouted, but at the last moment our copter banked away from the people who were obstructing the runway.

Our pilot cautiously set her down near the rent-a-car lot.

"We're a helluva a long way from my jet," Mr. Sirbuh protested. "What you expect us to do? Walk all the way through that crowd?"

They resembled a curling wave, a tidal wave approaching. A police car made a skidding stop in front of them. Two little policemen got out. The huge crowd gradually halted.

Their new signs included the words RADIATION and EARTHQUAKE. I saw very few of the old STOP DRILLING signs now, and there were no SAVE OUR BIRDS signs any more.

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"Get out," Mr. Sirbuh said to me. "I see a reporter."

I sat there. I didn't want to move.

He stood up inside our copter with his white head lowered to fit the curve of its plexiglass, and I heard the crowd roar. They'd recognized him. They flowed around the police car on both sides. Both policemen retreated until their backs were against our copter. The faces in the crowd were distorted by the plexiglass. I noticed smoke rising behind them. The fire seemed to be where our executive jet was parked, as if someone had tried to create a diversion to distract the rest of the police force.

I suggested to Mr. Sirbuh that we take off and give our interview by telephone.

"That's not how to meet the world, son." His warm hand closed around my shoulder.

"Explain to them," he shouted, "that the oil leak will increase. It will leak for years, unless a nuc safety device is exploded down there to shut it off. The only way to meet it is head-on."

I looked out through the plexiglass at their contorted faces. They were shouting so unintelligibly it sounded like howling, as if they were from another planet. They might be solid middle-aged citizens. But they were acting as if we were the invaders. A woman with a wildly distraught face hammered at our plexiglass with the stick from her sign.

"They're calming down," Mr. Sirbuh shouted. "Get out. I see another reporter. Explain to them they'll have to trust the good judgment of the experts. They haven't any choice. Don't just sit there, son."

My knee joints seemed welded. I felt as if my future would divide here if I stood up. I didn't want—

"Look at their faces," I began protesting and stalling for time. "That sign. It says PLOT," I cried, startled by the shrillness like hatred in my own voice. "They think you caused this oil leak on purpose. Like it's an excuse and you're trying to blast out your storage cavity in spite of everybody."

As if he were in pain, he looked down at me and his hand reached out. "Get up. You've got to decide."

"I can't." I looked up at his face and saw his agony.

"You're fired," he blurted and squeezed my shoulder. "You'll never . . . you've never been fitted for it."

He flashed his fierce old grin. "Good luck."

He stepped down between the two policemen. All three of them moved toward the police car, and the crowd parted. A reporter leaned in, thrusting a mike at his face. Mr. Sirbuh's white head turned away and he kept walking. I hoped he wouldn't say anything here. That was supposed to have been my job. To explain—

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I stood up in the copter when I saw the heavy-set man grab his shoulder. But Mr. Sirbuh easily shook him off. Little kids slid down from the hood of the police car as he strode toward it.

The same paunchy man lurched in front of him, arguing angrily. Mr. Sirbuh shoved him aside, and a roar like rage rose from the crowd. Mr. Sirbuh turned his head. I saw his teeth flash. He yelled something at them. I hoped it wasn't a challenge like *you can't stop progress.*

Those shrieks from the woman with the stick made her sound as if she were going insane. I was afraid he'd yelled something furiously frustrating to them like *you've got to choose between the oil and the bomb.*

The crowd surged. Someone took a round-house swing at him. As I started out of the copter, I saw his raised forearm deflect the second blow. I remembered him coming home at night with tape over his eye and grinning.

Now he shoved the crowd aside as if he were protecting the policemen. But one policeman struggled between him and the people. The other opened the rear door of the police car. Both policemen pulled him, pushed him.

He vanished below the heads of the crowd as I jumped out of the copter. One policeman was pushing people away so Mr. Sirbuh's door could be closed. I glimpsed his white hair. As he sat on the rear seat, he was yelling back at the crowd.

I called for him to wait for me. But he didn't hear me. His teeth gleamed. He shouted something at them.

People surged forward around me, and I heard his door slam. I thought he was safe. The other policeman squirmed to the front door of the car and got inside. I noticed the steel grating between the front and rear seats and realized the police car was designed for transporting prisoners.

The other policeman struggled around the rear of the car, trying to reach the opposite front door.

On this side, the people swayed and heaved. They were trying to open Mr. Sirbuh's door. I saw his face grinning at them through the safety-glass. His door was locked. I supposed the policeman in the front seat had activated some sort of remote-control latch, locking the rear doors, safely sealing Mr. Sirbuh in the rear compartment. His grin widened.

The car was rocking. I saw his face yelling defiantly at them through the glass. As if he had triggered all of their irritation from years of oil spills and hatred of the oil companies and frustration from their inability to be heard in Washington and fear of his nuclear device, they howled. We surged inward. I tripped over a fallen man.

As I stood up, to my amazement, the car's tires appeared on top,

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helplessly spinning. Its muffler and anti-smog device were obscenely exposed as the mob roared. The policeman in the front seat fell or dove out of his opened door.

They rocked the overturned car back and forth. Above their triumphant shouts rose shrill warning yells. I smelled gasoline. The mob recoiled.

In the bright afternoon sunlight, flames swept almost invisibly around the car. People fell back against me. I realized some idiot, or murderer, had unscrewed the gasoline cap from the upside-down car.

I felt heat against my face. There was a blinding, thudding blast, scorching— When I dropped my hands from my face, a blazing woman, still clutching her stick, collided with me. I fell. As I rolled on to my hands and knees, I noticed the asphalt paving under the car was bubbling. Swirling flames darkened against the sky.

Trying to keep my eyes open, I crawled below the terrible heat toward the car. My hand stuck in the asphalt. I heard myself howling with pain or hatred as I commanded my body toward the upside-down car. Through the searing heat, I tried to see what had happened to him. His door—

In the emergency ward, my hands felt cold rather than hot. I stared at the blaring TVs that even pursued me into my hospital room. Innocently, clumsily, deceptively, the evening news was showing old film clips of a totally different crowd. People were milling around holding up old SAVE OUR BIRDS signs. On a beach, an unrecognizable, oily mess was being raked into a pile. The news commentator nervously joked about straw, which was the primitive means of soaking up that oil, and camels' backs. This was as close as he came to attempting an explanation of what had-pened.

I was awakened by the Secretary's hoarse voice from the elevated television in my hospital room. "The President has instructed me to appoint a committee to—"

After a while Joe's face became aggrieved. He assured the TV audience that his Department had never given even serious consideration to any proposal to allow detonation of a nuclear device under the ocean. "We are so concerned with protecting our natural environment that a study will be authorized to—"

They didn't like to face risks. But Mr. Sirbuh laughed at risks all his life. He had to keep drilling if The Sirbuh Oil Exploration Company was to survive. And I have to keep living.

So I refuse to feel guilty. Whatever I should have said to him wouldn't have changed his life's direction. His life's drilling hole was already sixty-one years deep. It had trapped him.

At least he tried to understand our financial environment and our

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governmental environment and the compromises these partial environments required. He struggled with our deep-water environment. He gambled on the geological environment below that. But he didn't try to consider the whole environment. "Who can?" He'd shrug and grin. "Life's too short."

But our environment included those people in the coastal towns. I don't want to feel guilty. They were the ones who murdered him.

I'm afraid to sleep. Last night I dreamed oil was pouring over the world. The planet's face stretched as if shouting for help. Through the safety-glass of the upside-down police car, it recognized me. It grinned. My hands were searing. I was howling with pain and hatred through the glass as the flames stretched my father's fiery grin.

I didn't open the door.

It was too late for that.

In my hospital room, the oil was being televised from the orbiting satellite's eye. The vast expanse of oil gleamed north and south along the coastline and over the curve of the Earth.

Instead of making a real decision, the Secretary seemed to retreat into generalities about the future. "Too much of our irreplaceable oil reserve," he orated, "is being wastefully burned in automobiles, giving us momentary heat and speed, and more smog. But this administration will encourage the technological know-how and scientific breadth of vision to provide other means of power."

He seemed to prefer philosophizing to facing his big decision. "Our children's children will hate us for being so short-sighted. In oil-fired steam-electrical generating plants we're burning up the complex oil molecules which our future could use in the chemical industry for plastics and tires and dyes. The hungry people of future generations may hate us for burning the oil which, through bacterial conversion, could have provided them with high-protein food supplements."

When I was released from the hospital, I discovered he, or someone, had placed Marine guards on our drill ship. A destroyer cruised by. It was as if they feared the rioters, who killed my father, would attempt to walk on the water. From Washington, they denied rumors that the scientific committee was considering the use of an over-age submarine filled with nitroglycerine.

They ordered us to drill more relief wells, while oil sloshed over their inflated plastic booms, and currents snapped them. New boats pushing conveyer belts of absorbent toweling circled ineffectually in the oil. The continuous geyser in the big boil heaved up their huge iron hood from the bottom.

There was too much oil, too much pressure. Attempting to reduce it, we were madly pumping oil

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from our wells into uneconomic little barges. Our operating expenses became so awful that stockholders were screaming at me through long-distance phones. They were afraid the government wouldn't reimburse us and we would go broke. They acted as if they'd always believed their investment dollars were as safe with us as in a bank.

Mr. Sirbuh would have laughed.

To relieve the pressure in that gusher's immense field through our few little wells might take twenty years too long. He would have shaken his white head.

While the oil spread farther along the coast, more damage suits were filed every day, naming the government and The Sirbuh Oil Ex-

THE ANALYTICAL LABORATORY

It's time I think for a review of how we work out the figures in the Lab's reports; the system is simple enough, but new readers need a clue!

As reader votes come in, we mark 'em in on a monthly chart. A vote for first place for a story earns that story a "1" in its column; a vote for second place earns a "2", and so on.

At the time of make-up for the new issue, we close the accounting, and add up the total score each story has accumulated, and divide by the total number of votes.

Now if the nigh-impossible happened, and 250 readers unanimously agreed that "Whatzit," by Qudinunc Whoozit, was the best in the issue, there would be a long row of "1"s under "Whatzit", and when added and divided the point score would be 1,000, which would, of course, earn it first place in the An. Lab. report.

The order of ranking is determined by which won the most low-point votes.

A *low* point score means it won a lot of first-place votes, and, therefore, stands first in reader liking.

OCTOBER 1969

PLACE	TITLE	AUTHOR	POINTS
1.	The Yngling (Part 1)	*John Dalmas*	1.48
2.	Test Ultimate	*Christopher Anvil*	2.67
3.	A Relic of War	*Keith Laumer*	3.20
4.	The Big Rock	*Robert Chilson*	3.91
5.	Jump	*William Earls*	4.40
6.	Compassion	*J. R. Pierce*	4.85

THE EDITOR

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ploration Company and anyone else they could think of.

Some oil operators began asking the government to return their lease money and the enormous bonuses they had paid for their offshore tracts. The liability risks were greater than they'd been led to believe. They also wanted to be reimbursed for their exploration and development costs, plus something for the colossal estimated value of the oil pools they had discovered. But what government would give back billions of dollars?

A few oil companies were willing to exchange their off-shore leases for government-owned oil reserves on land. Bizarrely, this sagebrush-covered land was controlled by the Navy, who didn't want to give it up. But these oil operators began to exert pressure. They wanted to trade for land leases where they wouldn't have the great risks of pollution liability.

The ocean shimmered with iridescence like the spreading tail of a peacock, and the Mexican Government launched its damage suit against the United States through the World Court. That did it.

One night, without warning, the Earth trembled—almost imperceptibly. In the coastal towns, sleepers probably didn't even turn over in bed, or open their eyes.

In the morning, they discovered new signs had been planted along the beaches: POSITIVELY NO FISHING UNTIL FURTHER NOTICE.

Offshore they saw long gray ships circling. The other leased drill ship floated where the big boil had been. Its stubby workboats tended hoses. They were pumping down cement, grouting a few bubbling scars in the sea bottom.

The first cargo of oil which was drained upward from the nuclear-excavated cavity through the vertically drilled large-diameter holes and buoyed hoses, made the Navy tanker mildly radioactive. The Navy didn't offer to pay us for that first shipload of oil. I didn't complain or contest that in the courts.

It will take the courts years to decide whether The Sirbuh Oil Exploration Company lives or dies.

Mr. Sirbuh would have laughed.

The water became sparkling blue for a while. The beaches were opened to swimming within a month. Those people are accustomed to a little oil on their feet and oil darkening to tar on the rocks. There will be no fishing until further biomedical studies have been made. But this little blast was no Eniwetok or Bikini. It was merely a little tap, in the middle of the night. The Secretary, or somebody, had decided. It was one little bang, deep in the Earth.

Like he'd said it would, Mr. Sirbuh's nuclear proposal did the job.

He would have grinned. We're drilling more wells.

I feel like crying. ■

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the reference library

P. Schuyler Miller

"HUGO" TIME

I have not yet seen an official report of the "Hugo" award balloting from any fanzine, but my spies at the St. Louis convention brought back a fairly complete account of the winners. The results upset one of my cherished theories about the awards, and suggest that fandom —at least, voting fandom—finds itself uncomfortably on the fence about the "New Wave."

The convention was apparently the biggest and one of the best ever held. Whether the voting on the awards was also heavy, I don't know. Next year the world SF Convention will be both international and polylingual, for it goes to Heidelberg, where German fandom confidently expects to set records of its own. In 1971 it will be Boston's turn. I'll try to keep you informed, as I get information. Meanwhile, watch the magazines (*If* and *Amazing* primarily) that have regular fan departments.

The award for best SF novel of 1968 went to John Brunner's "Stand on Zanzibar"—and thereby collapses my venerable rule that no book can win unless it has been out in a paperback edition well ahead of the voting. Not only is Brunner's book massive and expensive in its hardback edition, it has been the center of a "'Tis not! 'Tis so!" slanging match in fannish circles. I'm told Ballantine had early copies of its paperback edition (No. 01713; 650 pages; $1.65) on sale at the convention, but this was too late to affect the voting. People bought it, loaned it, borrowed it. They liked it, in spite of the fact that it has far more in common with the great plot-weaving Victorians than with the hapless, hopeless introspective fiction of today. It may be that they *thought* they were voting for a New Wave novel, though the disciples of that movement have denied it vehemently.

Be that as it may, what seems to me to be the same effect gave *Galaxy* a complete sweep of the awards to shorter fiction: Robert Silverberg's "Nightwings" as best novella, Poul Anderson's "Sharing of Flesh" as best novelette, and Harlan Ellison's "The Beast That Shouted Love" as best short story. (*Fantasy and Science Fiction* took the "best magazine" award again, which I interpret as proof that most readers like both, and *F&SF*

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is the magazine that combines both most satisfactorily.)

"Nightwings" is the first of three parts of a rather strange book which Avon now has on the stands complete (No. V-2303; 75¢). I hope that the award in the novella class doesn't rule it out as a candidate for book-length honors, as happened with Ann McCaffrey's superb "Dragonflight." This story is another example of the way Bob Silverberg is branching out into wholly new areas of science fiction. As I recall, years ago when there were such things, he received a special Hugo as "most promising new writer." He is richly proving the rightness of that award, which was received with barely muffled snorts in his pot-boiling days. In "Nightwings" he is—for the first time as far as I can recall—experimenting with that borderland between science fiction and fantasy which has been the domain of Jack Vance in his "Dying Earth" mode.

Poul Anderson has failed to get awards for many far better stories than "The Sharing of Flesh." I am at a loss to know why he scored this time—and I suspect he is, too—unless it is because the high school and college-age readers who do most of the voting on the awards decided that the theme of the story was New Wave, antiestablishment, and deserved a vote of confidence—the equivalent of a vote for "Hair" or "Oh! Calcutta!" in the sock-'em-with-nakedness theater. You see, Poul very smoothly and very plausibly demonstrates that cannibalism is not only justified on cultural grounds—I've been waiting for a Black Panther to start an "Eat Whitey!" movement on religious grounds—but is essential biologically, in the situation he describes.

Harlan Ellison is Mr. New Wave in the U.S. of A. and his winning short story is the only one of the lot that can really be called part of that wave. It is now available in its unedited form, with its original full title, in a new Ellison short story collection, "The Beast That Shouted Love at the Heart of the World" (Avon No. V-2300; 75¢). Harlan posits a new structure for the psychic or psionic universe—a new variant of the parallel worlds theme that gives both structure and logic to that useful old horse. He writes, of course, with all his usual violence and intensity.

Best drama: "2001"—though I understand "Planet of the Apes" gave it hot competition. Happily it was not necessary for the fans to hand the rocket to another TV program. It may have won out over the apes because of its psychedelic finale and general air of mysticism.

Best fanzine: "Psychotic"—which changed its name to "Science Fiction Review" and is tops under any name.

There is a rising interest in mysticism and the occult among

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young people. (You can see coeds reading manuals of witchcraft on the buses, and a friend who teaches a night course in astronomy found that some of his miniskirted students were there to get "the" background for astrology.) In part this is a "democratic" revolt against the inflexibility of science, and it may be that in future awards we will see a swing away from "real" science fiction toward fantasy and the occult. It may be that this is the year when the swing started.

DIMENSION A

By L. P. Davies • Doubleday & Co., Garden City, N.Y. • 1969 • 206 pp. • $3.95

L. P. Davies is the Welsh optician and shop keeper who has done some good and some fair SF books, and is now working over an old formula for the younger set.

The heroes of the book are two teen-age boys, one of whom has lost his scientist uncle. Professor Maver has disappeared from a locked laboratory, and the boys discover that he has been trying to break through into a parallel universe, alias "Dimension A." Naturally they patch up his apparatus, naturally they blunder after him—first with a semi-primitive human lot, then with the totally nonhuman, telepathic Vorteds. Naturally, both the human Toparians and the nonhuman Vorteds want to conquer our own world.

The detail is excellent, but the book really is just a boys' book compared with the author's others, especially the classic "Paper Dolls."

OPUS 100

By Isaac Asimov • Houghton Mifflin Co., Boston • 1969 • $5.95

If this were not a ceremonially compiled book created especially as Isaac Asimov's 100th published opus (bibliography at the end), the publisher might have called it "Inside Asimov" or "An Asimov Reader," or something equally banal. Trust Ike not to get trapped into anything like that.

What we have here are a series of plums from his century of books and stories, plump, juicy, and embedded in a tasty batter of Asimovian commentary on himself, his works, his editors and publishers, his fans, his professions, and anything else that comes to mind. You know Asimov, and if you don't, you should.

In the "Mathematics" section you get, complete, the classic short story about the computer technician who discovered a new way of doing arithmetic. It's called "The Feeling of Power." In the "Chemistry" section (there are eleven categories in all, from robots to the Bible) is the full text of his third and least known dissertation on chronochemistry, "Thiotimoline and the Space Age." The original thiotimoline article appeared here in Astounding in 1948 and caused

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Dr. Asimov some troubled moments. It appeared just before he took his doctoral oral exam at Columbia. (Thiotimoline, for you newcomers, is a compound that dissolves 1.22 seconds *before* you put it in water. The consequences are remarkable.) What I miss in this section, though, is a bit of his equally great story elucidating the biochemistry of the goose that laid golden eggs.

There is also a third complete story, his latest SF yarn at the time the book went to press, "The Holmes-Ginsbook Device," a satire on that best-selling, all-revealing classic, "The Double Helix." You'll find the same basic gimmick in "The Feeling of Power."

Asimov the essayist-biochemist-mathematician-historian-aficionado-of-etymology-biblical commentator . . . all the Asimovs are here but Asimov the poet. What happened to him?

THE FUNCO FILE

By Burt Cole • Doubleday & Co., Garden City, N.Y. • 1969 • 282 pp. • $4.95

Doubleday didn't send this enjoyable yarn out with their science fiction, which only goes to show that one batch of editors doesn't always know what another lot are accepting. They *have* classed some straight supernatural fantasy as "science fiction," but under the house rules I've ignored it here.

The skeleton of the story is that the Machine, a super-computer buried somewhere in the mountains of the upper Delaware valley, becomes thoroughly confused by news and intelligence data on four maverick individuals. They deviate from what it has found to be the norm for human behavior, so it—and the Federal Deviation Investigation agents—sets out to track them down and turn them inside out. But three of the four are distinct individualists, the fourth is lucky, and the hunt isn't at all easy. It *is* fun.

First the author introduces us to his four deviates and the circumstances which got them into the news. Then he brings them together and the hunt starts. Finally, they confront the Machine.

Cole is a student of Ozark superstition and herb doctoring, and his most delightful section is the one about Rolf, the boy who can set off poltergeist ructions but can't stop them. We meet him in the company of a winning collection of country doctors, witches and hill people, follow him into the custody of a couple of highly respectable aunts, and agree with him that there is no way out except running away. He is also a student of Indian ethnology and the occult, and his next best deviate is Djeela-Lal, temple prostitute, adept at yoga (she can levitate to avoid getting grass stains on her sari), and top concubine to the ambassador from a negligible Asian principality with

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rather rough customs. She flees Washington to save her teeth and her life.

Number Three is Corporal Burns, a seemingly mutant soldier who has been trained by the Army and or CIA as a member of a completely conditioned secret murder group. If anyone comes within four feet his killing reflexes are activated . . . but he doesn't want to kill anyone but the sergeant who got him into the mess. And when he meets Djeela-Lal, taking a bath in the Delaware, a powerful conflict arises between his training and his instincts.

The fourth and least of the mavericks, Mr. Kleiber, has the least of the wild talents: he can write indelible letters of fire with his nose. Harmless or not, this kind of thing can't be tolerated, so he is on the run, too.

In a sense, the book is a parody of science fiction and spy fiction, but the author's evident delight in his hobbies, and in the foibles of thee, me and the folks down the street, makes his story enjoyable.

FIVE TO TWELVE

By Edmund Cooper • G. P. Putnam's Sons, New York • 1969 • 153 pp. • $4.50

This English writer hasn't written a great deal, but he hasn't repeated himself, either. His books aren't prize-winners or landmarks in SF, but every one of them has been worth reading.

The "five to twelve" of the title is the ratio of males to females in London of the next century. It is a world in which women have taken over society and men have become pets, parasites and scum. In this world, young Dion Quern, a would-be minor poet (whose verse is a good deal better than that offered by alleged major talents in some other books), is living by scrounging and stealing until he is trapped by big, blond Juno Locke, Chief Police Officer. She takes him on as a full-time stud—later even goes so far as to marry him and find a brood-mare by whom he can have a son—and then Dion finds himself trapped into another very different relationship with an underground group of males who want to destroy the female hierarchy.

The intricate, hopeless, growing relationship between the parasitic Dion and the dominant and domineering Juno is especially well developed. Plot and setting are inextricably interwoven, as they should be in any good SF novel.

THE NIGHT SPIDERS

By John Lymington • Curtis Books, New York • No. 123-07006-075 • 222 pp. 75¢

This is a book by a British writer which I never did manage to get in the hardback edition. Doubleday, for some reason, treated it as a detective story and never advertised it with its science fiction. It's an exceedingly strange

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one, and a good one, suggesting some of the hallucinatory gambits of the New Wave without really becoming nonsense.

Richard Chance, the hero, has a series of nightmares which he gradually comes to believe are actually short trips into the future. "Trip" in the LSD sense? In the familiar time-travel sense? We're never really sure. But in this future or pseudo-future, spiderlike beings from space are raining down like glowworms on an unsuspecting Earth. What they can do, and what they intend to do, develops slowly and horribly.

I'll watch for more by Lymington if he is always this good.

THE FINAL PROGRAMME
By Michael Moorcock • Avon Books, New York • No. S-351 • 191 pp. • 60¢

Jerry Cornelius is a kind of Conan of the New Wave of speculative fantabulation—or whatever SF now stands for in the avant garde. It might be better to say that he is the Cthulhu mythos of the New Wave. Michael Moorcock, onetime editor of *New Worlds,* originated him in this "novel" but other authors are making him the antihero of their "stories" just as a group of authors did with the assumptions and beings created by H. P. Lovecraft. I don't know whether they are trying to be consistent; I should think that they wouldn't bother, since the New Wave rejects the coherence and consistency of conventional fiction and moves with the kind of surrealistic logic you find in dreams.

"The Final Programme" might very well be made into the kind of film the Beatles had in "The Yellow Submarine," complete with its own ultramodern music. It might become a Rock opera with orchestrated light show. It might be almost anything, and it can't be described and make conventional sense. Miss Brunner, its villainess in the Daughter of Fu Manchu sense, is also in a way its heroine. The end carries back to the philosophical speculations of the alchemists of the Middle Ages and Renaissance, using an all-knowing, all-powerful computer to create "the world's first all-purpose human being." (An intensive course in Hermetic mysticism might be exactly what a reader needs to fathom what is going on.)

"The Final Programme" is by no means as far out as some of J. C. Ballard's recent stories in *New Worlds* or Moorcock's other Jerry Cornelius "adventures." May all of Lovecraft's most powerful entities help the poor befuddled soul who tries to fit all the Cornelius stories together. One question is worth raising, though: if the "real" universe is what it seems to us to be—and that is a perfectly respectable SF postulate—what is the real universe of someone stoned on hallucinogenic drugs?

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brass tacks

Dear Mr. Campbell:

Scanning some crime statistics I noticed that the street crime rate in "corrupt" cities or "gangster controlled" ones, is considerably lower than in democratically governed cities. Tax rates are also lower. Could it be that organized crime is giving citizens better protection at lower cost? If so, democracy in the United States is doomed!

ANDRESJS BAIDINS
1104 Windon Drive
Wilmington, Del. 19803

The Mafia believes in discipline, and has their own police force—"enforcers"—who don't know about "police brutality."

Dear Mr. Campbell:

Thank you for the check for "The Biggest Oil Disaster."

Because writers to "Brass Tacks" are so sharp, here is an explanation of the "transonic exec jet."

Readers will realize that "transonic" is the speed with greatest turbulence and assume it is not a feasible speed for a jet transport. But a "supercritical" wing design, with improved efficiency at sound speeds, reportedly has been developed by Richard Whitcomb of NASA. He was the designer responsible for the Coke-bottle fuselage shapes of the improved-model F-102, of the F-106 and B-58. Those used the "area rule" which reduces interference between fuselage and wing. Now the "supercritical" wing apparently would use sophisticated cambering to reduce turbulence and buffeting at sound speeds.

Installation of the "super-critical" wing may allow some existing jet transports to cruise as much as 100 m.p.h. faster. It might permit greater maneuverability for the proposed FX (F-15) air superiority fighter, and the Air Force has been considering this wing design, although it appears likely that a more conventional wing will be selected. "Super-critical" wings soon may be tested on an existing military fuselage. NASA requested funds for 1970.

In five to ten years, "transonic exec jets" may be flying.

Writers to "Brass Tacks" may be more aroused by the pros and cons of deepwater oil drilling along

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densely populated coastlines. Oil companies, and also the developers of competing deep-water systems with various types of capsules, production satellites, risers and minisubs, are investing a lot of money. But actual deep-water oil production seems to be in the primitive Sputnik stage of development, with unpredictable problems and malfunctions ahead. Until the companies have more experience down there, the "best" methods and equipment won't be known. It seems uneconomic, in the broader view of things, to use the densely populated Southern California coastline as the "guinea pig." Accidents will happen.

HAYDEN HOWARD

It might be nice to do such testing on the beaches of Antarctic—except there aren't any, and no known oil—which makes it difficult!

Dear Mr. Campbell:

Just a footnote to one of your editorials: Romania is full of water buffalo—called bivolihere. All my friends assure me that their milk and cheese are better than those of cows.

MALCOLM M. MCCLURE
Fulbright Fellow
University of Cluj
Romania

You find 'em in the oddest places!

Dear Mr. Campbell:

I was extremely elated to read your most timely and purposeful editorial in the May issue of Analog "Face Against Peace." With the thorough publicity given this rebellious minority in recent years, there are very few editors who have the courage to stand up and "tell it like it is."

Too many of our influential citizens, feeling the weight of so-called public pressure, are purposely blindfolding themselves to the true underlying problems of the Vietnam situation. Which, of course, fits into the pre-planned communist scheme of things, particularly the Oriental communist.

One great misconception our news media offers to the American people, is that the Asians couldn't care less whether they are ruled by a democratic or communist system of government. Granted, your illiterates may honestly feel this way but even your educated class often appears thus on the surface. This lack of emotion is interpreted by many Westerners as a true sign of the apathetic nature of these people. Little do many of them know how reserved Orientals are in expressing their emotions.

Our politicians have also dubbed the new Vietnamese leaders as corrupt and pompous. But with face so important to them, especially after being subjugated to foreign rule and foreign dependency, one can hardly blame them for being proud and overbearing.

My limited knowledge stems from my years of military service in

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Korea and Vietnam. I certainly don't profess to being an expert in either Oriental culture or philosophy. My experience has given me enough insight though to realize the significance of our presence in those troubled areas. Of course it is hardly necessary to visit those countries to see the folly of the peace movements. Incidentally, on the subject of peace movements, an editor of an anti-war magazine informed me that mine was a "rare outfit" in Vietnam, because I'd told him our morale was high as was our sense of purpose. I think what he meant was that I was a liar.

I must say, Mr. Campbell, I find it quite refreshing to read an editorial like yours in a quality S-F magazine. I am sure that all practical and realistic people who read Analog will heartily agree.

TOMMY R. KOVACH

Route 1
Akeley, Minnesota 56433

Considering the problems we evidently have in understanding fellow human beings—what'll we do about aliens who have a different philosophy AND different evolution?

Dear Sir:

In your editorial, September 1969 Analog, I wish to make one slight correction. Calcite, CaCO3 is not inert in the presence of fluorine or even hydrofluoric acid. Instead it reacts rather violently. Fluorite, CaF2 is inert to practically anything. Having taught introductory Geology it has been a favorite trick of mine to send a budding chemical genius into the lab with a sample of fluorite, easily recognizable by its cleavage, to identify. As you know the stuff doesn't react even to HF. Most gratifying.

I wish to compliment you on your recent editorial on gun legislation. As I am now working on my masters in Sociology, don't ask how I got there, it is refreshing to find someone of like mind. Witness prohibition.

How about a serial by Chandler?

BOB HAYLEY, JR.

Box 889
Seymour, Texas

Sorry—that was a pure goof on my part. I meant fluorite, of course.

As for analytical specimens —friend of mine got a mess of tar and barium sulfate as his "unknown"! That doesn't dissolve well!

Dear Mr. Campbell:

Your January editorial was pure vintage Campbell. I hope it will be reprinted or anthologized. I reread it each time you publish a letter objecting to it, and each time I enjoy it more. Your logic is unanswerable, but you won't convince the True Believers. They live in a logic-tight compartment with the valve controlled by emotion, and when you combine a definitive argument against firearms controls with one in favor of capital punishment, you hurt them so much that they can't

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think at all. To ask them to listen is as futile as to try to persuade a seventeenth-century witch finder to examine the evidence against witchcraft.

In the seventeenth century, however, nobody believed that witchcraft could be stamped out by turning loose known witches and trying to control the materials for witchcraft. They knew that witches would get the materials anyway and that non-witches would not misuse them. Our pseudo-liberal establishment is not so intelligent. Instead of persecuting the witches, it persecutes broom owners. In any reasonably sane society, the shooting of the Kennedy brothers by leftists would have caused a drive against subversives, as the anarchist murders of the nineteenth century created a campaign against anarchism. Instead, the United States—a nation which purports to be the world leader of anti-Communism—was swept by a wave of officially induced sympathy for Communists and other criminals and hysterical persecution of law-abiding gun owners. And this drive is spearheaded by the Kennedy family! The middle ages surely never produced worse mass lunacy.

People in the middle ages may have worried about witches and heretics; but they didn't worry about guns. Medieval society was entirely gunless, for guns hadn't been invented. According to the current theory, this should have produced tranquility, domestic and international, and made the task of law enforcement easy. It didn't work out that way. In medieval times, everybody who had anything worth stealing lived in a fort, and few ventured out by night—or in the country, even by day—without armed guards. Private citizens kept and carried arms for self-defense, for the weak was always at the mercy of the strong. The governments at times tried to suppress brigandage and murder and so did the church; but, lacking an effective police, their powers were very limited.

In these circumstances, the English kings showed very good sense. Instead of trying to disarm their subjects, they ordered everyone to keep a weapon in his home. When the militia was summoned, everyone had to appear ready for battle; and when a thief or murderer was caught in the act, and the "hue and cry" was raised, all citizens were required to turn out in arms to catch the offender and usually kill him on the spot. It didn't stop crime, but it makes more sense than to try to disarm its potential victims.

You needn't go back to the middle ages, though. In many places today, guns are rare because of the laws or because of the poverty of the people. Has this reduced killing? It is hard to believe it. In India, for example, few private citizens owned firearms when the Brit-

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ish left. Yet Hindus and Muslims immediately fell on each other—the identity of killers and victims depending on who outnumbered whom in various districts—and in a few days massacred an estimated two million. It took gun-toting Americans four years of civil war to rack up about one-quarter of that score.

In the face of mounting crime and threats of revolution and race war, Big Brother may find it hard to persuade even law-abiding people in America to give up their guns; but even if he did, he would only restore medieval conditions. A mob could always know that its victims could not shoot back. Gangs of robbers could storm private dwellings and even stores and hotels. If murderers should still prefer to keep killing in the family, they could always use knives or hatchets; but even these tools are not essential. Husbands can kill wives, parents their young children, or children their aged parents, with bare hands. If the intended victims are stronger or more numerous, murderers need only wait until they are asleep.

Not even a dictatorship can completely eliminate firearms, although its monopoly on their possession would greatly increase its chance of holding power. Statistics, however—unless doctored by propagandists—do not sustain the theory that such a monopoly would decrease crimes of violence. Some states and nations with very restrictive gun laws have high rates of violent crime, while others have low rates; and the same can be said of those with very permissive laws. Nor does the enactment or repeal of firearms legislation seem to affect the crime rate. The notion that pistols are especially dangerous is a delusion based on a delusion. Criminals often use them, in preference to rifles or shotguns, because they are easier to conceal and faster to get into action; but for the same reason, a handgun is the best defensive weapon for storekeepers and householders, and statistics do not reveal how often the use or even the presence of a pistol prevented a crime. There are no good and bad weapons; there are only good and bad people. Even the "stun gun" of science fiction could be abused by robbers, rapists, or kidnappers.

There is no demonstrable relation between crimes of violence and gun ownership. In the absence of a gun, people use whatever weapon is at hand. But there is a clear correlation between crime and its punishment—or lack of punishment. For many years, the incidence of crime has continually increased, while the speed, frequency, and severity of punishment has decreased. This may not be a simple causal relationship, but it certainly presents a strong prima-facie case for swifter, surer, and more severe punishments. There is also

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some evidence that the general public, in spite of years of intensive brainwashing, favors stricter punishment of criminals rather than more anti-gun laws.

LAURENCE LEE HOWE
1044 Eastern Parkway
Louisville, Kentucky 40217

And, finally, if you think a man without weapons is unarmed—ask any Karate expert!

Dear Mr. Campbell:

I have just finished reading the August Analog. In this issue you make reference to those "oh-so-HUMANITARIANS who mourn the miseries of the Vietnamese." You ask why, if they wanted to help the Vietnamese, didn't they? This is a question I have often asked. I now think that I, with your help, have come across the answer.

As a serviceman now serving in the Republic of Vietnam I know that these people, who truly want to help, are needed. Not only for medics and pacification teams, but also to help rebuild this war-torn country. Many of the soldiers here spend their free time teaching school or helping out at the orphanage, and to be quite honest, we could use some help. There is lots to be done, and it's not all guns and killing. The Vietnamese need educational and vocational aid to expand job opportunities, technical assistance to develop industry, agricultural programs to develop more and better food. Such programs as these have been put into effect by not less than forty countries and are always needing more people to work, the jobs are there.

The so-called Americans that demonstrate against the policy we have in Vietnam should take a closer look at the situation. If the demonstrators feel as deeply as they say about the welfare of the Vietnamese people, why don't they bother to find out what they can do for them; they will probably find that, whatever their skill, there is a job waiting to be filled which would help the people and not hurt a soul in the process.

So why don't they help? Perhaps you answered this question in "Brass Tacks" of your August issue when you said, "that's too dangerous for people who want to look like heroes cheaply."

Demonstrators who feel it is too dangerous for them to work in a country with a war going on in it should stop to consider that the Vietnamese people are living and working under these dangerous conditions every day, without complaint.

Or could it be that they don't really want to help; after all Fuzz-baiting is more fun than work.

JACK D. COPELAND
Sp/5 U.S.A.

All those interested—genuinely interested!—in the plight of the Vietnamese please prove it!

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EDITORIAL

continued from page 7

Most domestic loads are either low-magnitude—TV sets, ordinary reading lights, radios—or random-statistical. Refrigerator motors turn on and off—but it's a random process, and over a block of homes, the chances that *all* start at the same time is infinitesimal. Domestic oil burners are the same sort of load. Even electric ranges; different housewives do their cooking at slightly different times during the dinner-hour peak. That same random pattern applies to most domestic loads.

Except air conditioners.

Air conditioners are turned on at the same time—when the day gets hot—and most of the machines are designed for maximum utilization of capacity. Unlike refrigerator systems that have reserve cooling capacity enough to allow an on-off cycle, most air conditioners are sold on a minimum-size-that-can-do-the-job basis, and even though they have thermostats, they run all out continuously on any hot day.

This adds to another situation. The power rating of transformers, cables, all the power-handling and distribution equipment is based on the maximum tolerable temperature rise. A transformer rated at one kilowatt can handle ten kilowatts quite competently . . . for a short time, while the overload is warming up the metal to a point where the organic insulation burns through.

Those round, black tanks you see mounted up on power-line poles along the residential streets are commonly known as "pole pigs"; they contain the transformers that step down the 2,200 volt local-distribution current to the 220 volts used in most houses. They're installed and hooked up to a group of houses; the idea being that while the total demand of all the houses would seriously overload the pole-pig if it all came on at once—i.e., if every house turned on its electric range, electric clothes-dryer, electric iron, percolator, toaster, and all the lights at the same time—that random-statistical distribution in time would keep that from happening. The system worked just fine.

Until air conditioners came along. They *all* go on at the same time, and stay on. Moreover, they go on on the hottest days, when the sun is blazing down on the pole-pig keeping it nice and warm, and the air temperature has gone up to 95° or 100° and the transformer can't dissipate heat very well.

And from the viewpoint of the utility, it's not just one transformer that's being fried—it's all of them. And they're all loading down the substation transformers, so that

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even the big oil-cooler fans working full blast can't keep the temperature down.

Worse, in the cities where power lines and equipment have to be installed underground, the cables begin to heat.

Have you had to have your home rewired? Figure what such a rewiring job would cost when a whole city—New York City, say—has to be rewired, because the cables underground simply can't stand the constantly increasing load on them. They heat up; when the summer sun is frying the asphalt, and all the air conditioners are on, the ground gets warm—and the cables can't dissipate heat. They're insulated with assorted plastics—because only plastic can do the job of restraining 100,000 volts at 2,000 amperes into a pipe only four inches in diameter. One air gap, and that voltage jumps across; the resulting arc burns cable until an overload relay somewhere kicks out.

But plastics can't stand heat—it turns gooey, and lets hot, heavy copper cables sag against each other . . .

Moreover, there's currently a copper shortage; getting new cable isn't simply a matter of saying "Send me 250 miles of 100,000 volt 2,000 ampere cable!" Switch gear isn't available easily either; every utility in the country is facing the problems of rising power demand, and every manufacturer of such equipment is heavily backordered.

Last summer, Consolidated Edison in New York City—which has a combination of all those bad-situation headaches to contend with!—had one of their giant gigawatt generators down for necessary routine maintenance, when another one, at one of the other plants, developed an internal short-circuit and had to be yanked off the line.

Under Finagle's first law, naturally it happened at the most undesirable moment possible—on one of the hottest days of a succession of hot days. (Which had heated the ground and equipment through and through!)

The power demand at just that point had reached an all-time record of 7,266,600,000 watts—call it 7.3 gigawatts.

The rated capacity of all Con Ed's generating plants was 8.2 gigawatts—so that theoretically they still had a reserve capacity of about one gigawatt—except for the non-theoretical fact that 1.6 gigawatts of big generators were out of service due to (1) maintenance work, and (2) accidental damage. Con Ed was able to pull in power enough to carry the load by borrowing from up-state power stations, and by public pleas to consumers to cut down their demands. By allowing their voltage to drop from their standard of 120 volts—for house-

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hold lines—to 115, they lightened their load somewhat without interrupting service.

Naturally, the public put up a howl at being asked to limit their insatiable appetite for electric power.

Mr. Edison's Magic Lamp was showing its feet of clay—the Product was revealing that the Process existed, and was in trouble, and they want *Magic* lamps. No process to interfere.

Perhaps as much as 0.01% of the population of New York City had any awareness of what the trouble was; the other 99.99% "knew" it was all because Con Ed was not doing its proper—magical, process free—job. And perhaps 99.999% didn't want to know what the trouble really was.

For years Con Ed has been trying to get permission to build power plants. Technology says the proper place for them is as near the immense load-area as possible —i.e., in the city proper. Power's cheap at the bus bars—somewhere under 0.4¢ per kilowatt hour. But since you can't carry electric power home in a bucket, you have to pay for distribution—and that's expensive stuff. The optimum place for the generation equipment is in the City—but the public doesn't want it there. The objections are pollution—air pollution and heat pollution. The amount of heat thrown off by a two-gigawatt power plant burning fossil fuel is sufficient to seriously alter the ecology of the streams that heat has to be dumped into. Nuclear plants being less efficient thermally than fossil fuel plants, they cause even greater thermal pollution.

Since most of the energy consumption in New York City is electrical, most of the fuel consumed in the city is burned by Con Ed. (First Law of Thermodynamics: You can't get something for nothing!) This makes Con Ed look like a villain; other industries around the city can say virtuously, "See, we use clean power—*we* don't pollute the air!"

The major howl on pollution has to do with sulfur oxides given off by burning fuels. It happens that sulfur oxide emission is practically harmless to human beings. After all, friends, we evolved on this planet, and during the last two or three gigayears our life forms learned to live in an atmosphere into which volcanoes regularly spew a few cubic miles of sulfur dioxide every year. Today, the slopes of volcanoes are considered fine farm lands—despite the constant stink of SO_2 in the air. Sure SO_2 is poisonous—in quantity. So's water, salt, oxygen, and CO_2.

The sulfur oxides *do* have corrosive effects on metals and stone, and can be hard on fabrics. But since sulfur is absolutely essential to all forms of living tissues, every fossil fuel is inescapably tainted

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with some sulfur. And electricity is not magic—it involves a process of releasing energy from fuels.

Con Ed has, for years, been trying to get authorization for more nuclear-power stations.

"Oh, no! Atoms are so dangerous!

"Just give us more and more electric power, and stop trying to build all those big smelly, or dangerous, plants near us!"

There's one kind of power plant we can build that does not produce air pollution, and doesn't cause thermal pollution of streams —a hydroelectric plant.

Con Ed's a little handicapped there, because the southern New York area doesn't happen to have a handy Niagara Falls. Victoria Falls is in Africa, and there aren't many other places where a New York City size power-appetite could be satisfied hydroelectrically.

However, one of Con Ed's big problems is that business of huge peak loads during the day and early evening, and relatively light loads during the night. This means that their present generating stations, which are rapidly reaching saturation on those daytime peaks, have lots of spare capacity every night. It's a shame that you can't store AC power as the early Edison plants stored juice in the old storage batteries . . .

The company came up with a scheme to handle the problem. By building an artificial reservoir in the Catskill Mountains area, just out of the city, they could, during low-load periods, pump a few million gallons of water up hill to the reservoir during the night, and then let it run down, during peak power hours, driving generators during the day.

This involved building an artificial lake in a suitable spot; they'd have been able to store enough energy to supply two gigawatts of power during peak-load periods, for as long as twelve hours if necessary.

But the save-our-beautiful-lands conservationists killed that plan. The fact that the place would have been a new recreational area actually didn't alter things—a *corporation* wanted to do it for their *own advantage,* so that proved it must be nasty.

The general public doesn't claim magical powers—it just demands Magic of its servants. The People of the City of New York know what they want, by God, and they intend to make Consolidated Edison deliver! They want Mr. Edison's Magic Lamp—and no nonsense about building power plants that give off fumes, or might blow up and let atoms out. (There's no point whatever in explaining that (1) a power reactor is absolutely incapable of explosion, and (2) releases less nuclear radiation than the standard wrist watch, and (3) produces a lot lower radiation level than is found in a modern jet-

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liner's cockpit, with all its luminous-dial instruments. It's futile, because the Public has Ideas, and they're about as easy to change as the shape of a rubber doll. You can shove it over, but it always bounces right back where it was.)

Con Ed's power peak in 1960 was a mere 4.35 gigawatts. In 1969, it was 7.3 gigawatts, roughly. Assuming a simple linear increase in demand, though an exponential increase seems more probable, it would be 10.3 gigawatts in 1979. They're going to need, in the next ten years, at least three new one-gigawatt generators. Or else Mr. Edison's wonderful Magic Lamps are going to start flickering and going out quite regularly.

Let's consider what this means.

If you go into one of the suppliers of such equipment, and order the turbogenerators, transformers, switch gear, and necessary subsidiary devices for a one-gigawatt installation today, with a certified check for about $35,000,000 in hand, and say, "Gimme one of those!" you're not going to get it.

There are only two companies in the country that have the facilities to make turbo-alternators of that size—Westinghouse and General Electric. (Allis-Chalmers dropped out of the business because the profits are too low.) And remember—Con Ed's problems are *typical of every modern big city in the nation.*

This is not just a local-New York problem; everywhere the big city power companies face the same factors. People want Mr. Edison's Magic Lamp to work by *Magic*. They do *not* want the process—they want the product only.

So both of the big-generator manufacturers are up to their ears in orders now: you'll have to wait your turn.

A gigawatt generator is about two hundred feet long—and it has to be machined to a ten-thousandth of an inch. The sort of equipment that can handle 100-ton masses of iron, and machine to exact tolerances are not easily come by; the manufacturers can't increase their rate of generator generation suddenly either!

However, with a signed order and cash on hand, and a little pressure from various interested political figures, if you put your order in this month, you could probably start getting shipment in early 1973.

Of course, a turbo-alternator isn't going to do a bit of good, unless you have a steam source to feed it. And that's a tougher problem. There are several suppliers of gigawatt-size boiler systems—Combustion Engineering, the Babcock & Wilcox Co.—a few others. But like the turbo-alternator manufacturers, they're already loaded with orders, too. And boiler design and construction isn't as fast as generator building.

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For one thing, it's mostly hand work—and the Boilermakers Union is a strong one. They do not like to be rushed. Particularly the New York Local. In the southwest, things get done a good bit faster—but it's still a slow, long job, because there are miles and miles of tubing that have to be installed. Things that size can't be shipped all set up—they're erected on the site. And one of the limitations is the number of men that can be crowded into that tight-packed mess of tubes to work. You know the old arithmetic problem of "If two men can dig a 30-foot ditch four feet deep in five days, how long will it take . . ." Well, how long would it take one hundred fifty men? Answer: they'd never get it done because there wouldn't be any place to dig that there weren't feet in the way.

Since a gas-fired boiler is the least complicated, it could be ready soonest. And for that, you should be able to get steam up for the first time around the latter part of 1975. That's if we start *now*.

However, coal-fired boilers require more apparatus, and are trickier to build—say mid-1976 for that.

You'd have to add another twenty-five percent or so if in the New York area where Union rules slow things down.

And if you build a nuclear system, a still more complex boiler system is involved; that wouldn't be ready before 1977 at best.

And this, of course, means if you put in your finished order right now—it doesn't allow for the time required for engineering design studies when a specific location has been finally settled on.

At least, the long time required to get the hardware will give time to go through the financial operations necessary to raise the required money—something on the order of $150 per kilowatt of installed capacity.

But it doesn't allow for the time required to get public officials—sensitive to public sense-of-outrage—to say "Yes, go ahead; build the needed plant, of that needed type, in that location."

That's what *really* takes time! Getting the public to accept the fact that Mr. Edison's Magic Lamp does not work by magic.

It operates by a process, and the process involves power generation equipment that must be built before it can be used.

It's a very old story, that will probably afflict Mankind when there comes the problem of where the interstellar spaceport should be built, or where the fusion power station for the intergalactic matter transmitter should be located.

People are becoming more and more annoyed that Mr. Edison's non-magic lamp needs power stations. ■ The Editor.

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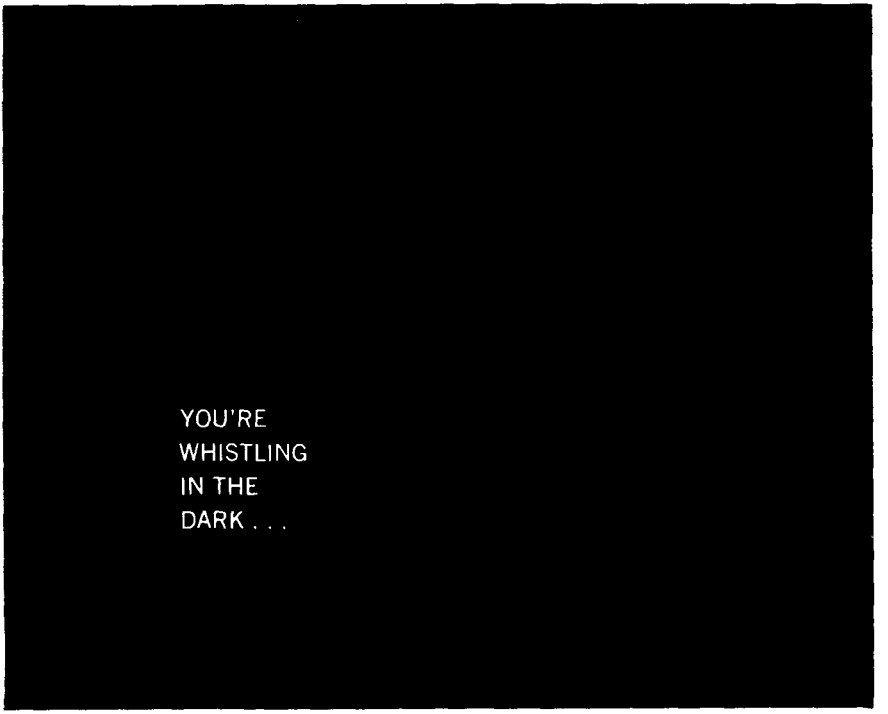

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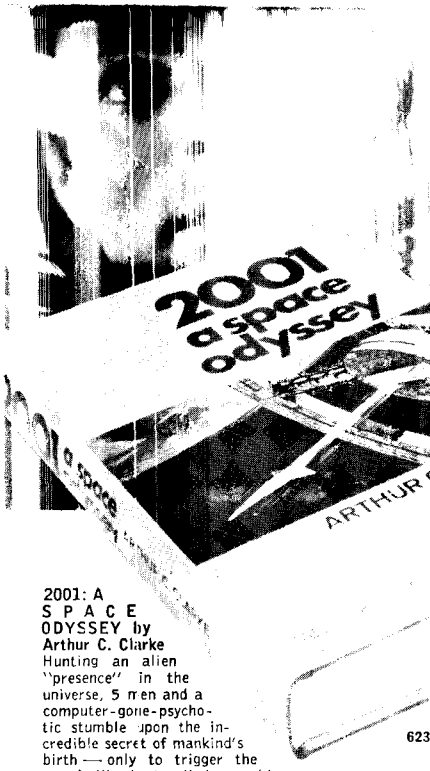

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